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AN ANALYSIS OF
A NAVY STOCK FUND
INVENTORY VALUATION MODEL

by

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The Comptroller General requires federal agencies to determine inventory values in accordance with the lower-of-cost-or-market accounting principle. The Naval Supply Systems Command (NAVSUP) is proposing for inclusion into the Department of Defense Stock Fund Regulations a model that determines the value of stock fund inventories in accordance with the Comptroller General's accounting policy. This research makes two recommendations that are intended to improve the proposed NAVSUP model's degree of compliance with the lower-of-cost-or-market accounting principle and to approximate the cost of the inventory more accurately. These two recommendations are incorporated into a second model. Using sensitivity analysis techniques, this research examined the differences in final inventory values produced by the two models under varying conditions and assumptions. It was found that under certain conditions the differences in final inventory values could be material.

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INVENTORY VALUATION MODEL

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ABSTRACT

The Comptroller General requires federal agencies to determine inventory values in accordance with the lower-of-cost-or-market accounting principle. The Naval Supply Systems Command (NAVSUP) is proposing for inclusion into the Department of Defense Stock Fund Regulations a model that determines the value of stock fund inventories in accordance with the Comptroller General's accounting policy. This research makes two recommendations that are intended to improve the proposed NAVSUP model's degree of compliance with the lower-of-cost-or-market accounting principle and to approximate the cost of the inventory more accurately. These two recommendations are incorporated into a second model. Using sensitivity analysis techniques, this research examined the differences in final inventory values produced by the two models under varying conditions and assumptions. It was found that under certain conditions the differences in final inventory values could be material.

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I. RESEARCH OBJECTIVE

A. INTRODUCTION

31 U.S.C. 3511 and 3512 give the Comptroller General the responsibility and the authority to establish generally accepted accounting principles for the federal government. The Comptroller General's accounting standard for inventory clearly states, "Goods to be consumed in normal operations...as well as goods held for resale to entities outside the federal government, shall be reported...at the lower of cost or market value" [Ref. 1].

In an attempt to comply with the lower-of-cost-or-market accounting principle, the Naval Supply Systems Command (NAVSUP) has developed a model that calculates final inventory values for each of several large categories of material, called budget projects. NAVSUP has proposed that this model (the proposed NAVSUP model) be incorporated into the Department of Defense Stock Fund Regulations. The proposed NAVSUP model is actually a process involving calculations and a decision point. Raw data concerning the Navy Stock Fund inventory is input into the model; a final inventory value, designed to be consistent with the lower-of-cost-or-market accounting principle, is the output of the model.

The proposed NAVSUP model consists of two distinct and separate processes prior to the lower-of-cost-or-market decision point. One process determines cost (measured by approximate acquisition cost) and the other determines market value. Henceforth, the thesis will label those steps within the model that determine approximate acquisition cost as the "cost process." Likewise, the thesis will label those steps within the model that determine market value as the "market process."

B. RESEARCH HYPOTHESES

There are two features of the proposed NAVSUP model that demand attention. First, the proposed NAVSUP model chooses between the lower of cost and market value, and then considers the "utility" and "serviceability" of the material. Second, the proposed NAVSUP model uses an implicit price deflator generated from price changes experienced in cash outlays from the Department of Defense (DoD) Procurement Appropriation. The proposed NAVSUP model uses implicit price deflators in the cost process to convert current year replacement costs to approximate acquisition costs.

While the proposed NAVSUP model complies with the spirit of the lower-of-cost-or-market accounting principle, this thesis examines two hypotheses:

1. The proposed NAVSUP model should make a procedural change, and consider the inventory's "utility" and "serviceability" during the market value process, and not after the lower-of-cost-or-market decision point;
2. The proposed NAVSUP model should use a Navy Stock Fund implicit price deflator, which would calculate a cost of Navy Stock Fund inventory more representative of approximate acquisition costs.

The thesis will incorporate the procedural change and the Navy Stock Fund implicit price deflator into an alternative inventory valuation model (the research model).

The research model is very similar to the proposed NAVSUP model. The research model will use the same raw data and contain two separate processes to determine cost and market value. However, the research model will consider the material's "utility" and "serviceability" during the market value calculation process. Consequently, the research model alters the decision point between cost and market value, making it the last step in the inventory valuation process.

In addition, the research model replaces the DoD Procurement Appropriation implicit price deflator with a Navy Stock Fund implicit price deflator. This change overcomes two distinct problems. The DoD Procurement Appropriation implicit price deflator includes price changes from all of the military services, and not from the Navy alone. In addition, this implicit price deflator includes the price changes experienced in the purchase of high-priced inventory spares for the Navy Stock Fund as well as tanks,

aircraft, ships, and other major weapons systems. Other organizations within the military services account for these weapon systems. The Navy Stock Fund does not.

The Navy Stock Fund implicit price deflator is produced by the Department of Commerce's Bureau of Economic Analysis. This implicit price deflator has the advantages of being generated from information provided by the Navy Stock Fund, and excludes data from purchases made by the other services.

C. RESEARCH QUESTIONS

1. Primary Research Question

Given the preceding hypotheses, the following primary research question will be examined:

> Does the proposed NAVSUP model produce final inventory values that are materially different from the final inventory values produced by the research model?

2. Subsidiary Research Questions

Four subsidiary research questions will address specific issues. The first subsidiary question addresses final inventory values and financial reports. The data that NAVSUP provided for this thesis contained the final inventory values that would have been reported for Fiscal Year 1990 if the proposed NAVSUP model had been used for financial reporting purposes. The first subsidiary question will compare what the NAVSUP and the research models would

have calculated as the Navy Stock Fund's final inventory values for the Fiscal Year 1990 financial reports:

1. Using Fiscal Year 1990 data and holding constant all other variables, does the proposed NAVSUP model create final inventory values for Fiscal Year 1990 that are materially different from those produced in the research model?

The researcher expects that the degree of difference between the final inventory values produced in each of the two models will depend on the values of the variables in the models. Each of the next three subsidiary questions will identify as an intervening variable a factor that contributes to the inventory valuation process in the NAVSUP and research models, and will use sensitivity analysis techniques to vary the intervening variable over a wide range. Each of these three subsidiary questions will determine how final inventory values produced by the NAVSUP and research models fluctuate with increases in the intervening variables:

2. Holding constant all other variables and increasing the value of inventory at standard price, [1] does the proposed NAVSUP model create final inventory values

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[1] The phrase "value of inventory at standard price" is a macro-level measurement in dollars of how much material is in any one budget project. Each line item in the inventory has a standard price, and the quantity of that line item multiplied by its standard price determines the value of that one line item at standard price. The sum of the value of inventory at standard price for each line item in a budget project determines the "value of inventory at standard price."

that are materially different from those produced in the research model?

3. Holding constant all other variables and increasing the percentage of insurance material, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?

4. Holding constant all other variables and increasing the amount of annual sales, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

1. Scope

The thesis will concentrate solely on ways to put a value on secondary items (repair parts and supplies) in the Navy Stock Fund in accordance with the lower-of-cost-or-market accounting principle, and will use models that calculate inventory values by budget project. The thesis will examine only four budget projects, which are identified and defined in Chapter II. Finally, the thesis will use data that pertains to material in the possession of the Navy Stock Fund.

The thesis will not examine the following:

1. The value of principal items carried on Navy inventory ledgers;

2. Material on Navy Stock Fund ledgers but considered in transit;

3. Alternative methods to the lower-of-cost-or-market accounting principle;

4. Line item inventory valuation procedures.

In addition, Chapter VI identifies one variation of the proposed NAVSUP model and one variation of the research model that are both beyond the scope of this thesis. The researcher will recommend that these two alternative models be studied in future research.

2. Limitations

The thesis will focus strictly on inventory valuation procedures using data from the Navy Stock Fund. The thesis will not investigate issues and procedures peculiar to, nor request data from, the stock funds operated by the U.S. Army, U.S. Air Force, the U.S. Marine Corps or the Defense Logistics Agency. Therefore, the data and conclusions will apply strictly to the Navy Stock Fund.

3. Assumptions

NAVSUP constructed the proposed NAVSUP model using Fiscal Year 1990 data, and provided this data to the researcher. The thesis will use the Fiscal Year 1990 data to build the research model and to generate final inventory values from the research model. The thesis assumes that the Fiscal Year 1990 data is representative of typical figures that would be expected to be found during normal operations of the Navy Stock Fund.

E. RESEARCH METHODOLOGY

The researcher will refer to federal government accounting policies from the GAO's <u>Policy and Procedures</u>

Manual for Guidance of Federal Agencies. As stated earlier, the Comptroller General requires inventories to be valued at the lower of cost or market value. A review of the accounting literature will determine the accounting profession's interpretation of the lower-of-cost-or-market accounting principle. The thesis will present the arguments against a strict interpretation of the lower-of-cost-or-market accounting principle, and recommend that Navy Stock Fund inventory valuation models comply with the fundamental concepts of this principle, and not necessarily with the literal rule.

The proposed NAVSUP model and its terminology, equations and assumptions will be explained. In addition, a numeric example using hypothetical data will be processed through the proposed NAVSUP model. The fundamental concepts of the lower-of-cost-or-market accounting principle from the literature review will be applied, and the thesis will present the arguments for a procedural change that includes "utility" and "serviceability" in the market valuation process. The thesis will also argue that the Navy Stock Fund implicit price deflator should be included into the cost process. Finally, this procedural change and the Navy Stock Fund implicit price deflator will be incorporated into the research model.

Two sources provided the research data. NAVSUP provided the NAVSUP inventory valuation model in a computer

spreadsheet. The Bureau of Economic Analysis provided implicit price deflators for Navy Stock Fund purchases from 1972 to 1990.

1. Simulated Fiscal Year 1990 Financial Statements

The first subsidiary question addresses what the proposed NAVSUP model would have estimated for the Fiscal Year 1990 financial statements. This information was readily available from the NAVSUP spreadsheets, and no additional computations were required. The researcher used the same information for Fiscal Year 1990, and processed the data through the research model. The results are provided in a data table.

2. Intervening Variables

The researcher uses a three step approach to answer the last three subsidiary questions. First, the researcher identifies the three variables in the NAVSUP and research models that will act as intervening variables, and explains how these three intervening variables affect final inventory values. The three intervening variables are:

1. The value of inventory at standard price,
2. The percentage of insurance material, and
3. Annual sales at standard price.

Second, the researcher uses sensitivity analysis techniques to answer the subsidiary questions. Holding

constant all other variables, the intervening variable is increased over a range of values, and simulated measures of final inventory values in both the NAVSUP and research models are obtained. Third, these simulated final inventory values from both the proposed NAVSUP and research models are presented on the same graph to facilitate comparison between the final inventory values produced by both models.

3. Research Model As The Standard

For all four subsidiary questions, the research model will be used as the standard, or the baseline, as to what final inventory values should be. The thesis will measure the differences in final inventory values from the proposed NAVSUP model against final inventory values from the research model.

4. Analysis

The analysis will measure the differences in final inventory values with consideration given to:

1. Bias, or the tendency for the proposed NAVSUP model to produce higher or lower final inventory values in comparison with those produced by the research model;

2. Accuracy, or how closely the proposed NAVSUP model produces final inventory values in comparison with those produced by the research model, and;

3. Material differences, or differences in final inventory values produced by the NAVSUP and research models where these differences exceed 10% of the final inventory values of the research model.

F. ORGANIZATION OF THE THESIS

Chapter II introduces the background material and theoretical framework for the thesis. Federal government accounting policy and the lower-of-cost-or-market accounting principle are the two major topics discussed. Chapter III argues that a NSF inventory valuation model should not follow a literal interpretation of the lower-of-cost-or-market accounting principle, but should comply with the fundamental principles. Chapter IV describes in detail the proposed NAVSUP model and provides a numeric example using hypothetical data.

In Chapter V the researcher concurs with the proposed NAVSUP model's consideration of "utility" and "serviceability." This chapter also presents the arguments for incorporating "utility" and "serviceability" into the market value process and the use of the Navy Stock Fund implicit price deflator for insurance material. This chapter also processes the same numeric example through the research model that was processed through the proposed NAVSUP model.

Chapter VI explains the research methodology and why the three intervening variables were selected. This chapter also presents and analyzes the data. Chapter VII summarizes the principle findings of the study, conclusions, recommendations, and topics for additional research. This chapter also provides specific answers to the primary and four subsidiary questions. The appendices contain NAVSUP's

proposal for a revised inventory valuation model, and a list of acronyms and definitions.

II. BACKGROUND REVIEW AND THEORETICAL FRAMEWORK

A. INTRODUCTION

This chapter provides the background information and theoretical framework for this research. The federal government's accounting policy on inventories and inventory valuation will be discussed first. Then, the lower-of-cost-or-market (LCM) accounting principle is defined, and the accounting literature is reviewed for interpretations of the LCM principle. This chapter also introduces the concept of a stock fund and briefly describes how the Navy Stock Fund (NSF) operates. NSF financial reports, terminology and policy issues will also be discussed. Finally, the concept of an implicit price deflator (IPD) will be examined. The research will describe concepts and terminology in sufficient detail for the reader to understand the discussion presented in later chapters.

B. FEDERAL GOVERNMENT ACCOUNTING POLICY

Under the authority granted in 31 U.S.C. 3511, the Comptroller General is responsible for establishing the accounting policies and principles for the federal government. 31 U.S.C. 3512 requires all federal departments and agencies in the executive branch to comply with the Comptroller General's accounting policies and principles,

and to use these policies and procedures when preparing their annual financial statements.

The Comptroller General publishes these accounting principles and policies in Title 2 of the GAO Policy and Procedures Manual For Guidance of Federal Agencies. Title 2 broadly defines inventory:

> Inventory of the federal government consists of tangible...property (goods) (1) to be consumed in normal operations, (2) to be incorporated in production of goods for later consumption in normal operations, or (3) in process or finished that will ultimately be sold. Included are goods in the hands of others, yet owned by the government [Ref. 1].

A subsequent paragraph in Title 2 excludes construction in progress and plant, property and equipment from the definition of inventory.

Unequivocally, the Comptroller General requires federal agencies to use the LCM accounting principle for inventories:

> Goods to be consumed in normal operations (including raw materials or goods in process that will be completed for later consumption), as well as goods held for resale to entities outside the federal government, shall be reported...at the lower of cost or market value [Ref. 1].

The Comptroller General allows federal agencies to include in the historical cost of the inventory all amounts paid or payable, except interest, to bring the material to their present condition and location.

The Comptroller General gives federal agencies wide latitude on how they determine the cost of the inventory, and states that standard costs are acceptable:

> The method of applying costs to inventory items shall be determined using an acceptable method that reasonable reflects the costs in the inventory.
>
> Standard costs or standard prices is one method of valuing inventory. Where standard costs or standard prices are used, such standards must be adjusted periodically to reflect a reasonable approximation of costs.... Inventory already valued shall be adjusted for the new standard cost or price [Ref. 1].

The NSF sells inventory at standard prices which consist of two components, the last acquisition cost of the material and a surcharge to cover operating expenses. Section E of this chapter will discuss surcharges in more detail.

C. THE LOWER OF COST OR MARKET ACCOUNTING PRINCIPLE

This section will examine the LCM accounting principle as it has been defined by the Financial Accounting Standards Board (FASB). The FASB is the designated organization in the private sector for establishing standards for financial accounting and reporting. Therefore, this examination of the LCM accounting principle will define terms and concepts as they are used in the private sector. Diagrams and examples will demonstrate how the professional accounting literature interprets this principle.

Traditional accounting recognizes that cost is the fundamental means for determining the value of all assets. The FASB applies this fundamental rule to inventories:

> In keeping with the principle that accounting is primarily based on cost, there is a presumption that inventories shall be stated at cost [Ref. 2:p. 27,520].

The FASB also defines the concept of cost as:

> [T]he price paid or consideration given to acquire an asset; [cost] includes the applicable expenditures and charges directly or indirectly incurred in bringing the asset to its existing condition and location [Ref. 2:p. 27,525].

Therefore, cost represents more than just the purchase price of inventory in a business transaction. Cost measures the value of inventory by the total amount of economic resources sacrificed:

1) To obtain possession of the inventory in a business transaction where there is an exchange of ownership, and;

2) To bring the inventory in its current condition to its current location.

The FASB allows inventory managers to capitalize into the cost of the inventory the purchase price plus transportation and freight charges, storage and insurance costs, special handling assessments, and taxes.

The cost of an item in the inventory is a static measure and, once established, never changes. Consequently, as the

material is damaged, deteriorates or becomes obsolete, cost may overstate inventory values. Under these circumstances where inventory values are seemingly less than cost, the FASB authorizes a departure from cost as the means to determine inventory values, and allows the use of the LCM accounting principle:

> A departure from the cost basis of pricing the inventory is required when the utility of the goods is no longer as great as its cost. If the utility of goods is impaired by damage, deterioration, obsolescence, changes in price levels, or other causes, a loss shall be reflected as a charge against the revenues of the period in which it occurs. The measurement of such losses shall be accomplished by applying the rule of pricing inventories at cost or market, whichever is lower. This provides a practical means of measuring utility and thereby determining the amount of the loss to be recognized and accounted for in the current period [Ref. 2:p. 27,521].

In contrast to cost, which was described as a static measure determined by actual past expenses, market value is a dynamic measure which is determined primarily by the inventory's utility. The inventory's material condition, current market conditions, price level changes, and other economic phenomenon may also affect the market value:

> The term "market" shall be interpreted as utility on the inventory date and should be thought of in terms of the equivalent expenditure that would have to be made in the ordinary course of business at that date to procure corresponding utility. As a general guide, utility is indicated primarily by the current cost of replacement of the goods as they would be obtained by purchase or reproduction [Ref. 2:p. 27,525].

Equation 1 provides a simple way to remember the relationship among market, utility and current replacement cost (CRC) as they have been defined up to this point:

Equation 1

$$\boxed{\text{Market Value} = \text{Utility} = \text{CRC}}$$

However, market value is more complex than simply utility and current replacement cost. Market value and utility are subjective measures of value that require a subjective process. The FASB tempers the degree of subjectivity in this process by establishing boundaries within which market value must fall:

> The term <u>market</u> means current replacement value (by purchase or by reproduction, as the case may be) except that:
>
> a) Market shall not exceed the net realizable value (estimated selling price in the ordinary course of business less reasonable predictable costs of completion and disposal), and;
>
> b) Market shall not be less than net realizable value reduced by an allowance for an approximately normal profit margin [Ref 2:p. 27,525].

Market value, therefore, is the final value attributed to an inventory after making three subjective judgements regarding:

1) The inventory's utility (measured by current replacement cost (CRC) or reproduction cost);

2) Net Realizable Value/Ceiling (a maximum value), and;

3) Net Realizable Value/Floor (which is Net Realizable Value/Ceiling less a normal profit margin and provides a minimum value).

Equation 2 illustrates this relationship among market value (or utility measured by CRC) and its boundaries, Net Realizable Value/Ceiling (NRV/C) and Net Realizable Value/Floor (NRV/F).

Equation 2

NRV/C	>	Market Or Utility	>	NRV/F

Equation 2 does not suggest that CRC (which is the primary determinant of utility) will always be less than NRV/C and greater than NRV/F. It is possible that CRC may be greater than NRV/C and less than NRV/F. Table 1 shows the three possible scenarios, and the true market value is shown in the middle. For these three possible scenarios, a general rule simplifies the decision process; after determining CRC, NRV/C and NRV/F, the middle of the three values becomes market value. Figure 1 provides in flow chart format the decision process required to calculate market value and to choose the lower of cost and market value. The researcher adapted Figure 1 from an intermediate accounting textbook [Ref. 3].

TABLE 1
LOWER OF COST OR MARKET
DECISION TABLE

Greatest Value	>	Market Or Utility	>	Lowest Value
NRV/C	>	CRC	>	NRV/F
CRC	>	NRV/C	>	NRV/F
NRV/C	>	NRV/ F	>	CRC

NRV/C and NRV/F are intended to prevent a corporation from overstating or understating profits over time and therefore manipulating its income. For instance, NRV/C ensures that the inventory write-down to market in the current period sufficiently covers all anticipated losses, and prevents the recognition of further losses in the future. NRV/F prevents the corporation from recognizing an excessive loss in the present period and unrealized profits in the future. Table 2 gives eight examples of how to apply the LCM principle. The researcher adapted Table 2 from an intermediate accounting textbook [Ref. 4].

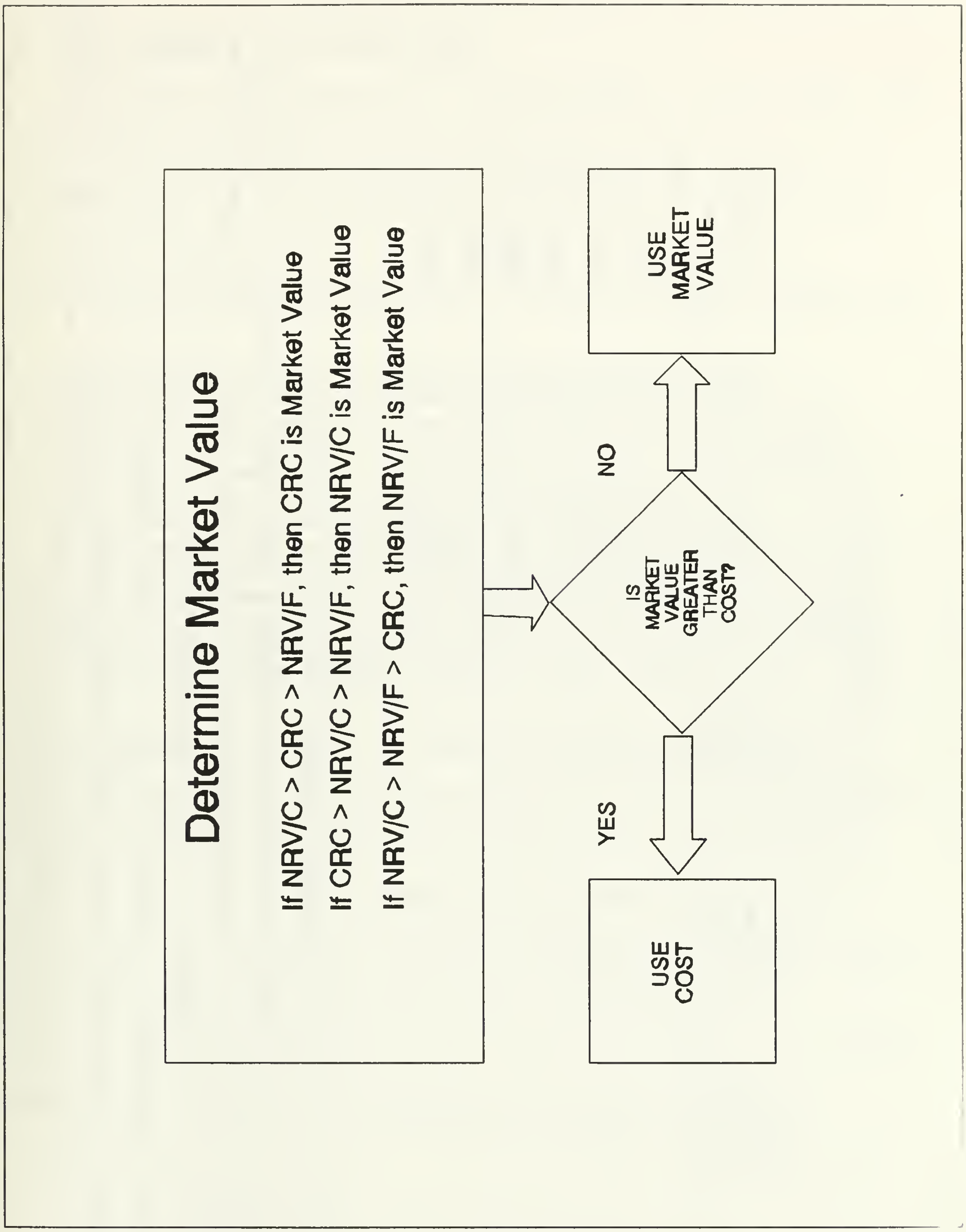
Determine Market Value
If NRV/C > CRC > NRV/F, then CRC is Market Value
If CRC > NRV/C > NRV/F, then NRV/C is Market Value
If NRV/C > NRV/F > CRC, then NRV/F is Market Value
IS MARKET VALUE GREATER THAN COST?
NO
USE MARKET VALUE
YES
USE COST

Figure 1

TABLE 2
CASE STUDY OF THE LOWER OF
COST OR MARKET ACCOUNTING PRINCIPLE

CASE	NET REALIZEABLE VALUE (CEILING) NRV/C	CURRENT REPLACEMENT COST CRC	NET REALIZEABLE VALUE LESS NORMAL PROFIT (FLOOR) NRV/F	MARKET VALUE	COST	INVENTORY VALUE
A	$16	$14	$12	CRC $14	$10	COST - $10
B	$14	$16	$12	NRV/C $14	$10	COST - $10
C	$16	$12	$14	NRV/F $14	$10	COST - $10
D	$8	$6	$4	CRC $6	$10	MARKET - $6
E	$6	$8	$4	NRV/C $6	$10	MARKET - $6
F	$8	$4	$6	NRV/F $6	$10	MARKET - $6
G	$6	$12	$4	NRV/C $6	$10	MARKET - $6
H	$14	$6	$12	NRV/F $12	$10	COST - $10

Case A: Cost is less than current replacement cost.

Case B: Cost is less than net realizeable value/ceiling which was less than current replacement cost.

Case C: Cost is less than net realizeable value/floor which was greater than current replacement cost.

Case D: Current replacement cost falls inbetween the floor and ceiling, and is less than cost.

Case E: Net realizeable value/ceiling is less than current replacement cost, and is also less than cost.

Case F: Net realizeable value/floor is greater than replacement cost,and is also less than cost.

Case G: In this case current replacement cost is greater than cost. However, net realizeable value/ceiling is less than replacement cost, and less than cost.

Case H: In this case current replacement cost is less than cost.. However, cost is less than the market value (net realizeable value/floor).

D. THE CONCEPT OF A STOCK FUND

Defining the concept of a "stock fund" at this time will enhance future discussions of NSF terminology and policies. A stock fund is a body of working capital used to finance inventory supplies, and thus consists of two major components, money and material. The NSF has been defined as:

> a working capital fund used to purchase and hold inventories of supply items. Items purchased by the stock fund are held at the stock point until they are needed by a customer. In effect, the final costing for the item is deferred until issued to the ultimate user. When items are issued from the stock fund to user activities, the user's financing appropriation reimburses the stock fund for the items drawn, thus providing resources which can be used by the stock fund to purchase new items or to replace inventory that has been sold. Because of this last feature, stock funds are categorized with the government's accounting structure as revolving and working capital funds [Ref. 5].

Stock funds do not rely on annual Congressional appropriations for financing daily operations. Congressional appropriations are needed only when the NSF must increase the size of its working capital to accommodate a larger investment in inventory. Financing NSF operations from user appropriations and not from annual Congressional appropriations allows the stock fund to concentrate on their chartered objective, an optimal inventory posture.

E. NSF REPORTS, TERMINOLOGY AND POLICY

This section introduces three specific issues relevant to this research, NSF financial reporting requirements that require the use of the LCM accounting principle, secondary material and inventory stratification, and stock fund pricing policies and surcharges.

1. NSF Financial Reporting Requirements

NAVSUP must prepare and submit several NSF financial reports that must comply with the LCM accounting principle. The highest levels of the federal government, including Congress, read these financial reports. Since these reports describe the NSF's stewardship of the taxpayers' money, the NSF must properly interpret the LCM accounting principle. In addition, the NSF must issue financial statements with inventory values that reflect the truest possible picture of the NSF's inventory posture.

For example, 10 USC 2208 requires the Department of Defense to report annually on the condition and operation of working-capital funds. The NSF complies with this requirement with the submission of Standard Form (SF) 220, "Statement of Financial Condition" and SF 221 "Statement of Income and Retained Earnings." These financial statements treat the stock fund as an operating entity, and report a variety of accounting measures, including inventory on hand. In addition, Title 10 Section 2701 of the National Security

Act of 1947 (amended) requires a more detailed report on the value of inventories. The Supply System Inventory Report (SSIR) satisfies this requirement, and stratifies the inventory by type of material and stocking objectives. Stocking objectives are defined below.

2. Secondary Material And Inventory Stratification

The NSF holds an estimated $30 billion in inventory, and stratification allows NAVSUP to categorize this inventory into manageable and meaningful segments. The stratification process has three purposes:

1) Stratification provides a means of uniformly portraying the Navy secondary item inventory of supply system assets stratified by purpose for which held and the readiness of the Navy supply system to supply material as specified in logistics guidance documents;

2) Stratification provides a means of uniformly generating and portraying secondary item funding requirements for the Navy in preparation and support of its budget submissions;

3) Stratification provides uniform requirements elements and a uniform sequence of allocating secondary item assets to requirements for related supply management operations, i.e., retention and transfer policy, management of the material pipeline, including peacetime operating and safety levels of supply, management of mobilization reserve stocks, management of material in long supply, and selective inventory management of secondary items [Ref. 6:p.1].

Stratification accumulates, extracts and displays basic supply data in a manner that relates assets to requirements in a specific priority and time sequence. NSF managers may array requirements against this time sequence, and apply NSF

assets thereto [Ref 6:p. 2]. Therefore, stratification allows NSF managers to measure how well current NSF assets can satisfy future requirements.

Secondary items consist of consumable supplies, material, reparable parts and equipment components that are carried in the NSF and that are not principal items. Secondary items differ from principal items in that secondary material do not require centralized control over every aspect of the asset's life.

The stratification process provides several different ways of dividing and categorizing all secondary material. There are four ways of categorizing secondary material that are important to this research:

1) By budget project;
2) By insurance or replenishment material;
3) By stocking objectives, and;
4) By material condition.

The NSF uses budget projects to classify material into easily identifiable groups with the same end use. The researcher acknowledges that a thorough analysis should include all budget projects in the NSF. However, insufficient time was available to perform the analysis for all of the budget projects, so the analysis was done for four of them. Table 3 identifies these four budget projects:

TABLE 3
BUDGET PROJECTS AND DESCRIPTION

Budget Project	Description
Budget Project 14	Shipboard Consumables
Budget Project 34	Aviation Consumables
Budget Project 81	Shipboard Depot Level Reparables
Budget Project 85	Aviation Depot Level Reparables

Within each budget project, the stratification process classifies material as either insurance material or replenishment material. Insurance material is:

> A non-demand based, stocked, essential item for which no failure is predicted through normal usage, but if a failure is experienced, or loss occurs through accident, abnormal equipment/system failure or other unexpected occurrences, lack of replacement would seriously hamper the operational capability of a weapon or weapon system [Ref. 7].

This thesis defines replenishment material as all secondary material other than insurance material, or, in other words, all secondary material for which failure is expected and customers will most likely have repeated demands.

Each line item of material can have any one of six stocking objectives. A stocking objective justifies the inclusion of an asset into the NSF inventory. Two of the more important stocking objectives for this research include Approved Force Acquisition Objective (AFAO) and Potential Excess (PE), both of which are defined here:

Approved Force Acquisition Objective (AFAO) - The quantity of an item authorized for peacetime acquisition to equip and sustain the U.S. approved forces in accordance with the latest Secretary of Defense Logistics Guidance [Ref. 8:p. 2].

Potential Excess (PE) - The quantity of an item above all authorized retention levels, but for which final determination as DoD excess has not been made. Stock may not be held in this category longer than is required to determine whether to retain the stock or process to disposal [Ref. 8:p. 3].

Other stocking objectives include Approved Force Retention Stock (AFRS), Economic Retention Stock (ERS), Contingency Retention Stock (CRS), and Numeric Retention Stock (NRS). AFRS is the quantity of an item in addition to the AFAO, required to support and equip U.S. approved forces from D-day until production equals the rate at which the item is required. ERS is that portion of the quantity of an item excess to the AFRS which has been determined will be more economical to retain for future peacetime issues instead of replacement of future issues by procurement. To warrant economical retention, ERS items must have a reasonable predictable demand rate. CRS is that portion of the quantity of an item in excess to the AFRS for which there is no predictable demand or quantifiable requirement, and which normally would be allocated as potential DoD excess stock, except for a determination that the quantity will be retained for possible contingencies. NRS is the quantity of an item in excess of all requirements objectives, but for which disposal is currently infeasible or uneconomical, or

for which a management decision has been made to retain stock in the supply system.

Finally, in addition to stocking objectives, the stratification process may classify each line item of material as to material condition. The proposed NAVSUP model classifies equipment components, repair parts, and consumables as either "serviceable" or "unserviceable."

"Serviceable" material requires no repairs, complies with its intended specifications, and can be issued to stock fund customers for consumption. Therefore, the proposed NAVSUP model values "serviceable" material at 100% of its replacement cost.

"Unserviceable" material is broken, does not meet its intended specifications and must be repaired before it can be issued to stock fund customers for consumption and use. Therefore, the proposed NAVSUP model reduces the replacement cost of "unserviceable" material by the average amount of repairs needed to bring the asset to a fully useable state.

The need to consider the "serviceability" of material emanates from the unique nature of the material held in the NSF. For example, the NSF inventory contains sophisticated equipment components and repair parts that have been broken and that are more cost effective to repair at a Navy repair depot than to purchase a new asset from the manufacturer. These depot level reparables (DLRs) have a

long life cycle involving warehousing-issue-usage-failure-repair and back to the warehouse for issue to another customer. As a line item in the NSF inventory, DLRs are unique in comparison to the traditional concept of material which may have a life cycle of warehousing-issue-consumption or warehousing-issue-usage-disposal.

The discussion has introduced the four major ways to categorize material through the stratification process. Stratification within the NSF starts at the budget project level. Within a budget project the stratification process may classify a line item of inventory into any one of twenty four categories according to stocking objectives and material condition. Figure 2 identifies the twenty four categories:

Insurance Material

	Serv	Unserv
AFAO	X	X
AFRS	X	X
ERS	X	X
CRS	X	X
NRS	X	X
PE	X	X

Replenishment Material

	Serv	Unserv
AFAO	X	X
AFRS	X	X
ERS	X	X
CRS	X	X
NRS	X	X
PE	X	X

Figure 2
Secondary Material
Within Each Budget Project

Each "X" in Figure 2 represents the value of inventory at standard price for that particular category. Therefore, stratification allows NSF managers a means to value the

insurance and replenishment material within each budget project by serviceability or stocking objectives.

3. Stock Fund Pricing Policies and Surcharges

Item managers are assigned responsibility for stocking an item in the NSF and establishing the standard price. For any line item of material the item manager determines the standard price from two components, the last acquisition cost from a representative procurement and a surcharge. Stated differently, the sum of the last acquisition cost and the surcharge is the standard price. The item manager may estimate the standard price for those items without a procurement history by using current manufacturer's price listings or market price quotations.

In general, the NSF pricing policy has a multitude of objectives, two of which are relevant to this discussion. The NSF must cover all operating expenses and maintain the real value of its working capital. In addition, the NSF is not supposed to generate profits or incur losses, and adjusts standard prices annually in order to remain close to the break even point.

The NSF uses the surcharge to recover five types of operating costs:

1) First destination transportation (FDT) charges within the fifty United States and overseas locations;

2) Inventory expenses associated with physical losses, obsolescence and defective material;

3) Maintenance for inventories which are required over and above demand replacement;

4) Price stabilization to compensate for inflation or deflation and prior years gains or losses, and;

5) Overhead expenses [Ref. 9].

Surcharges are also adjusted annually. This process contributes to the annual update of standard prices.

F. IMPLICIT PRICE DEFLATORS

Chapter I stated that the NAVSUP and research models use IPDs to convert the replacement cost of inventory in the current year to approximate acquisition costs from prior years. This section contains a brief review of the concept of an IPD. IPDs measure inflation for a basket of goods that changes from one period to the next, and are the ratio of the cost of purchases in current year dollars to the cost of purchases in constant dollars (base year dollars). Equation 3 shows the formula for IPDs, which is called the Paasche formula [Ref. 10]:

Equation 3

$$\boxed{\frac{\Sigma\ (\ P_{1i}\ \mathrm{X}\ Q_{1i}\ )}{\Sigma\ (\ P_{0i}\ \mathrm{X}\ Q_{1i}\ )}}$$

The summation over the index i is done to incorporate all of the goods in the "basket" chosen for the index. P_{1i} is the current year price for item i and P_{0i} is the constant year price for item i. Q_{1i} reflects the quantity of item i purchased in the current period, and may change from one period to the next. Q_{1i} provides the weights to be applied to the prices, P_1 and P_0.

As a measure of inflation, IPDs measure the purchasing power of the dollar. However, since the quantity of goods Q_{1i} may change from one period to another, the Q_{1i}'s can represent the basket of goods that an organization purchased in any one period of time. During the next period of time and for every period of time after that, this basket of goods may change. Since IPDs provide a means to measure cost growth experienced in the purchases of many different goods in different quantities across several time periods, they are an appropriate means to convert the replacement cost of an inventory to its approximate acquisition cost.

Since IPDs measure inflation for a changing basket of goods, they are different from other price indices such as the Consumer Price Index (CPI) or Producer Price Index (PPI) which use fixed quantities from one period of time to the next. The CPI and PPI measure price changes for an

unchanging mix of goods over a period of time. [2] The CPI and PPI are based on the Laspeyres formula which is shown in Equation 4 [Ref. 10]:

Equation 4

$$\frac{\Sigma\ (\ P_{1i}\ X\ Q_{0i}\ )}{\Sigma\ (\ P_{0i}\ X\ Q_{0i}\ )}$$

G. CONCLUSION

The objective of this chapter was to provide the reader with the necessary background information and theoretical framework for this research. The reader should remember the following four ideas while reading the remainder of this thesis. First, all federal agencies including DoD must report their inventory values using the lower-of-cost-or-market accounting principle. The highest levels of the federal government read these reports. Second, the FASB states that market value measures the utility of the material, where utility is usually represented by CRC.

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[2] The researcher acknowledges that the CPI and PPI have not always used the same basket of goods since these measures were first developed. For instance, the basket of goods for the CPI has been amended over the years to account for new products and changes in consumer preferences. The CPI uses this new fixed basket of goods until additional changes in the consumer market warrants a new fixed basket of goods.

However, when obsolescence, deterioration and damage impair the utility of the material, the value of the material must reflect this impairment of utility. Material that is impaired may be valued according to the material's NRV. Third, the stratification process provides four ways to categorize secondary material. For the purposes of this thesis, the most important way to categorize secondary material is by budget project. Finally, the proposed NAVSUP model uses IPDs to convert the replacement cost of inventory in the current year to approximate acquisition costs from prior years.

III. INTERPRETING THE LOWER OF COST OR MARKET ACCOUNTING PRINCIPLE

A. INTRODUCTION

The development of inventory valuation models requires an interpretation of the LCM accounting principle. This chapter contains arguments against a strict interpretation of this accounting principle, and asserts that NSF inventory valuation models should comply with the intent of the LCM accounting principle, and not necessarily with the literal rule.

B. ARGUMENTS AGAINST A STRICT INTERPRETATION OF THE LOWER OF COST OR MARKET ACCOUNTING PRINCIPLE

Chapter II discussed the LCM principle, and defined market value as the utility of the material. The LCM principle measures utility by choosing the middle value among CRC, Net Realizable Value/Ceiling (NRV/C) and Net Realizable Value/Floor (NRV/F). Table 4 reiterates the decision table for the three possible scenarios:

TABLE 4
LOWER OF COST OR MARKET
DECISION TABLE

Greatest Value	>	Market Or Utility	>	Lowest Value
NRV/C	>	CRC	>	NRV/F
CRC	>	NRV/C	>	NRV/F
NRV/C	>	NRV/F	>	CRC

In this thesis the argument is made that a NSF inventory valuation model that follows a strict interpretation of the LCM accounting principle would create final inventory values that do not accurately reflect the dollar value of the inventory in the NSF. The primary issue revolves around the inherent difficulty of applying private sector accounting principles to public sector organizations.

First, the NSF prices its inventory to cover all operating expenses, but does not intend to operate at a profit. In accounting parlance, profits are measured by net income, and Equation 5 shows that profit margin is determined by dividing net income by net sales. If NSF profits are zero, then the NSF's net income and profit margin would also be zero. Since the NSF operates without profits and without a normal profit margin, the absence of a

normal profit margin hinders the determination of NRV/C and NRV/F.

Equation 5

$$\text{Profit Margin} = \frac{\text{Net Income}}{\text{Net Sales}}$$

Recall that NRV/F was NRV/C less a normal profit margin, and profit margin was the only difference between the two. If the NSF's profit margin is zero, then Equation 6 applies.

Equation 6

$$\text{NRV} = \text{NRV/F} = \text{NRV/C}$$

The phenomenon in Equation 6 requires a revised lower-of-cost-or-market decision table for zero profit margins, which is provided in Table 5. In each of the three scenarios market value will always be NRV (regardless of the "C" and "F" distinction). CRC is relevant only when CRC equals NRV (the first scenario). Regardless of this possible but unlikely scenario where CRC equals NRV, market value will still be equal to NRV.

TABLE 5
LOWER OF COST OR MARKET
DECISION TABLE
FOR ZERO PROFIT MARGINS

Greatest Value	>	Market Or Utility	>	Lowest Value
NRV/C	=	CRC	=	NRV/F
CRC	>	NRV/C	=	NRV/F
NRV/C	=	NRV/F	>	CRC

In a strict interpretation of the LCM accounting principle a decision table for zero profit margins will always choose NRV, and NRV becomes the only determinant of market value. This reliance on NRV deviates significantly from the FASB's concept of market value, which states that market value relies primarily on CRC which is bounded by NRV/C and NRV/F. Without a normal profit margin, CRC is relegated to a secondary role. This reasoning leads to a major procedural and theoretical question, "Should the NSF inventory valuation process rely so heavily upon NRV?"

The definition of NRV starts with selling price. Since NSF inventory that is ready for issue to NSF customers is sold at standard price, a literal interpretation would reason that standard price (as the NSF's selling price) would satisfactorily represent the selling price as required

in the determination of NRV. However, there are two arguments why the standard price for material that is ready for issue to NSF customers does not adequately measure inventory values.

First, the standard price for NSF material is not a true selling price. The NSF does not operate in a perfectly competitive market, and its prices are not subject to the forces of competition. Rather, the NSF operates as the main supply organization in a multidivisional Navy. Pursuing this line of reasoning, standard price is actually an internal transfer price, and the transfer price has already been negotiated. Market forces have no influence on this transfer price at the time the NSF sells the material. In addition, the concept of a selling price implies that customers buy their material from commercial suppliers in the market. In contrast, NSF customers do not "buy" in a competitive market. In military parlance they "requisition," or literally demand their material from the NSF.

There is a second argument against NRV as the primary determinant of inventory values. Standard price was defined as the sum of last acquisition cost plus a surcharge for operating expenses. However, the surcharge is not really part of the inventory, and includes expenses (ie., overhead) that in the private sector are not allowed to be capitalized into the cost of the inventory. In a hypothetical situation where the amount of inventory is held constant and operating

expenses are unusually high, an increase in the surcharge to cover these operating expenses will inflate standard prices and reflect an inventory value not representative of the amount of material sitting in the warehouses. In this case standard price as the selling price in the determination of NRV may not send the proper signal regarding the NSF's stewardship of public funds.

The FASB stated that CRC was to be the primary determinant of market value. In the possible event that inflation had increased CRC to an unusually high figure or that deflation had decreased CRC to an unusually low price level, the LCM accounting principle required CRC to fall within some reasonable boundaries in the form of ceilings (NRV/C) and floors (NRV/F). NRV provided those boundaries, and was not intended to be market value in virtually all situations, as Table 5 suggests.

In summary, a strict interpretation of the LCM accounting principle applied to the NSF would place a heavy emphasis on standard price as the selling price in determining NRV. However, the standard price for NSF material that is ready for issue is not a true selling price but an internal transfer price. Surcharges to cover operating expenses increase standard price, and include expenses that should not be capitalized into the cost of the inventory. A standard price that includes operating expenses does not adequately measure the value of the inventory.

1. The FASB And Implementation Of The LCM Accounting Principle

The FASB recognizes the difficulties in applying the LCM accounting principle:

> Because of the many variations of circumstances encountered in inventory pricing, [the previous paragraphs regarding CRC, NRV/C and NRV/F] are intended as a guide rather than a literal rule. They should be applied realistically in the light of the objectives expressed in this section and with due regard to the form, content, and composition of the inventory [Ref. 2: p. 27,522].

Therefore, these arguments and the FASB's acknowledgement of the difficulty in applying the LCM accounting principle lead to the conclusion that a strict interpretation does not provide an adequate framework to determine inventory values in the NSF.

2. GAO Interpretation Of The LCM Accounting Principle

The Government Accounting Office (GAO) also supports an inventory valuation approach based on CRC, and questions the reliability of inventory values based on NRV when no market exists. In a financial audit of the Air Force's financial statement, the GAO reported:

> Market valuation involves application of either (1) current replacement cost (by purchase or reproduction) or (2) net realizable value (by sale or contemplation of sale), where completion and disposal costs and normal profit margin are considered. However, since the Air Force cannot readily sell its inventories because no market exists, current replacement cost by purchase or

reproduction is a viable alternative [Ref. 11:p. 66].

The GAO interpretation of the LCM accounting principle supports the argument that NRV is not a viable means to value inventories in the absence of a market.

C. CONCLUSION

This chapter presented the arguments against NSF inventory valuation models that follow a literal interpretation of the LCM accounting principle. A literal interpretation would lead to a NSF inventory valuation model with a zero profit margin decision table that always selects NRV in the process to determine market value. In addition, if the standard price for material ready for issue to NSF customers is used as the selling price in the determination of NRV, this standard price will consist of operating expenses and unallowable capitalized costs, and will not adequately measure the amount or value of the inventory.

Two additional arguments support the abandonment of a literal interpretation of the LCM accounting principle in the development of a NSF inventory valuation model. First, the FASB recognized that the LCM accounting principle could not be applied to all situations, and advised not to apply the LCM accounting principle as a literal rule. Second, in their audit of Air Force financial statements, the GAO acknowledged that the absence of a private sector market to

sell government inventories frustrates the inventory valuation process as the LCM accounting principle intended the inventory valuation process to be. The GAO recommended the use of CRC determine inventory values.

IV. A DISCUSSION OF THE PROPOSED NAVSUP MODEL

A. INTRODUCTION

Chapter II made two points that are particularly relevant to the forthcoming discussion. First, federal agencies are required to use the LCM accounting principle in determining inventory values for financial reports. Second, the Comptroller General authorizes federal agencies to use an acceptable method that reasonably reflects the value of the inventory.

This chapter will describe the concepts, terminology, equations and assumptions found in the proposed NAVSUP model. Then, the chapter will show how the proposed NAVSUP model works, using a numeric example.

B. A BRIEF HISTORY OF THE PROPOSED NAVSUP MODEL

In an attempt to comply with the LCM accounting principle, NAVSUP developed a model that was approved by DoD in 1986 (the 1986 model) and included into the DoD Stock Fund Regulations. The 1986 model has been used to determine the inventory values to be reported on the SSIR. However, the 1986 model assumed that the cost process would always produce the lower inventory value, and consequently ignored the market process and the lower-of-cost-or-market decision point. In 1990 NAVSUP changed the model, and incorporated

the market process and the lower-of-cost-or-market decision point into the inventory valuation process (the 1990 model). The 1990 NAVSUP model was used in the 1990 SSIR reports [Ref. 12].

In 1991, NAVSUP submitted a proposal to change the DoD Stock Fund Regulations recommending the use of the proposed NAVSUP model in the place of the 1986 model [Ref. 13]. The proposed NAVSUP model is similar to the 1990 model, and has the market process and the lower-of-cost-or-market decision point into the inventory valuation process. However, one important difference between the 1990 model and the proposed NAVSUP model is that the proposed NAVSUP model values Potential Excess (PE) material at its estimated disposal or salvage value, which is a procedure that has not been used in determining inventory values for SSIR reports.

C. DISCLAIMERS REGARDING THE DESCRIPTION OF THE PROPOSED NAVSUP MODEL

In this thesis the researcher is concerned only with the proposed NAVSUP model, and not with any other inventory valuation model. In the sections below that describe the proposed NAVSUP model, the researcher relied solely on the explanation of the proposed NAVSUP model provided in "Proposed Changes to DoD 7429.13-R Stock Fund Regulations" and computer spreadsheets provided by NAVSUP [Ref. 13]. Appendix C is a copy of the proposed NAVSUP model. However,

Appendix C is a highly technical document that people knowledgeable in stock fund operations can use to implement the proposed NAVSUP model. The researcher felt that this chapter required a simpler description of the proposed NAVSUP model, and therefore used Appendix C as a guide in explaining the proposed NAVSUP model in terms that accommodate people who are not familiar in stock fund operations. In some instances slightly different terminology has been used.

The researcher acknowledges that this chapter's description of the proposed NAVSUP model is an interpretation of Appendix C. In the event of any discrepancy between Appendix C and this description of the proposed NAVSUP model, Appendix C shall be considered correct.

The researcher also acknowledges that future discussion and negotiation of inventory valuation issues at NAVSUP and DoD may change current inventory valuation policy and practices. Therefore, in the event that the researcher's description of the proposed NAVSUP model conflicts with current NAVSUP or DoD inventory valuation policy or practices, the NAVSUP or DoD inventory valuation policy or practices shall be considered correct.

D. A DESCRIPTION OF THE PROPOSED NAVSUP MODEL

Figure 3 shows that the proposed NAVSUP model consists of five steps and one decision point. The name of each step comes from the variable whose value is the output of the step. The decision point simply chooses the minimum value between cost and market value.

The main input data for the NAVSUP model is the raw data from each budget project. This raw data includes, but is not limited to, the following information:

1. The value of inventory at standard price,
2. The percentages of insurance and replenishment material;
3. Stratification percentages;
4. Annual sales;
5. Estimated "utility" and "serviceability" percentages, and;
6. Surcharge percentages.

Using this raw data, the model determines a final inventory value for each budget project. When the final inventory values for the four budget projects used in this research are added, the result is the "cumulative final inventory value."

Step 0 begins the inventory valuation process, and obtains the value of the inventory at standard price from the Navy Regional Finance Center (NRFC) Financial Inventory Reports (FIR). The FIR is an inventory ledger account that

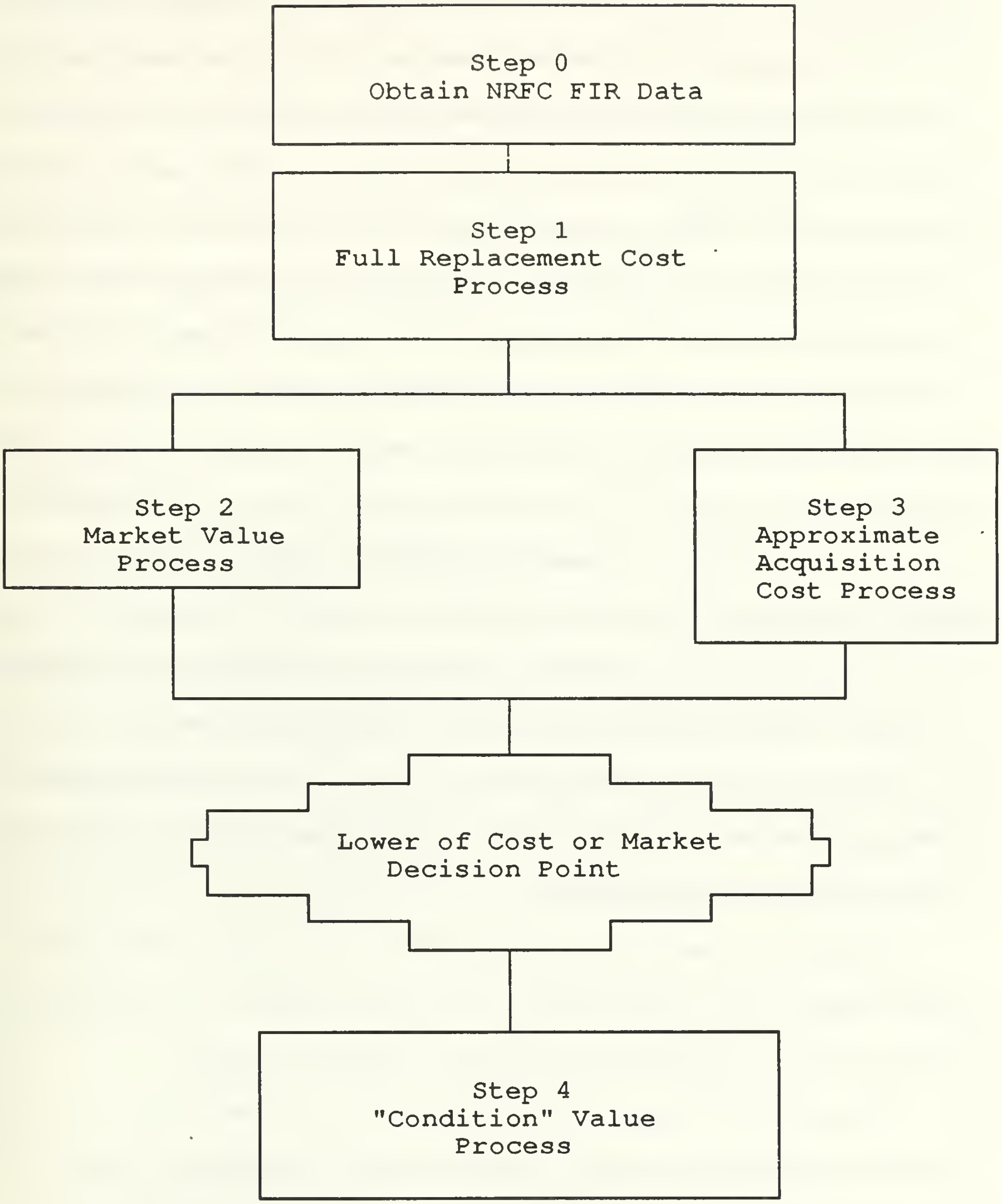

Figure 3
Proposed NAVSUP model
Determination of Final Inventory Values
By Budget Project

records and tracks the value of Navy Stock Fund inventory. The FIR is similar to an accounting journal's T-account. The FIR reports under various alpha-numeric inventory account codes the value of opening inventory, receipts and issues of material, all other transactions that increase or decrease the value of the inventory, and ending inventory. Navy shore and afloat activities that hold NSF material use the FIR for inventory management and reporting purposes. The FIR is generated at the activity level, and inventory values are reported up through the administrative chain of command.

In the opening and ending inventory accounts, the FIR reports the value of the inventory at standard price. Step 1 takes the value of inventory at standard price of a budget project, and calculates the full replacement cost.

Step 2 is the market value process. Full replacement cost and market value are the same figure, and no additional calculations are required.

Step 3 is the cost process. This step takes the full replacement cost from Step 1, and uses IPDs to calculate an approximate original acquisition cost.

Taking the output from the critical lower of cost or market decision point, Step 4 considers the "utility" and "serviceability" of the material. Step 4 produces the "condition" value which is also the final inventory value in the proposed NAVSUP model.

The five steps of the proposed NAVSUP model are described below. Terminology is defined and assumptions are introduced. Each step will be described in terms of the input value, the output value, and the process that convert the input value into the output value. With the exception of determining the value of the inventory at standard price (which is part of Step 0), the proposed NAVSUP model performs all calculations for an entire budget project. There are no calculations that are performed on a line item basis.

1. Step 0: Obtain NRFC FIR Data

Step 0 is the starting point for the proposed NAVSUP model. The NRFC FIR reports the value of inventory in a budget project. Equation 7 shows that the value of the inventory at standard price is the sum of the value of each line item in the budget project. Q_i represents the quantity of an item i. P_i represents the standard price of item i.

Equation 7

$$\boxed{\text{Budget Project's Value of Inventory} = \Sigma\, Q_i\, P_i}$$

2. Step 1: Full Replacement Cost Process

Step 1 starts with the value of inventory at standard price from Step 0, and converts this value to full

replacement cost.

Step 1.1 Replacement cost is the last acquisition cost from a representative procurement for all material in a budget project. This step determines the replacement cost for the entire budget project by dividing the value of inventory at standard price by the annual surcharge percentage, as shown in Equation 8.

Equation 8

$$\text{Replacement Cost} = \frac{\text{Value of Inventory At Standard Price}}{(\text{1 + Annual Surcharge Percentage})}$$

Step 1.2 This step capitalizes first destination transportation (FDT) charges to the initial storage point into the replacement cost. The output is called full replacement cost. Equation 9 calculates full replacement cost by multiplying replacement cost by the FDT surcharge as a percentage of replacement cost:

Equation 9

$$\text{Full Replacement Cost} = \text{Replacement Cost X (1 + FDT surcharges \%)}$$

The stratification process provides the percentage of insurance material and the percentage of replenishment

material. These percentages are applied to full replacement cost, and give two separate values. Full replacement cost now consists of the dollar value of insurance material and the dollar value of replenishment material. They become the input data for both the cost process and the market value process.

3. Step 2: Market Value Process

There are no additional steps between full replacement cost and market value. In the proposed NAVSUP model full replacement cost and market value are the same value. The thesis intentionally uses two names for the same number in order to avoid the confusion as to why in Figure 3 the cost process starts with market value.

Consequently, market value is also defined as the total estimated costs that would be incurred by purchasing the material in its current condition and transporting the material to its initial storage point. Equation 10 calculates market value, and is identical to Equation 9:

Equation 10

$$\boxed{\begin{array}{c}\text{Market Value} = \\ \text{Full Replacement Cost} = \\ \text{Replacement Cost X (1 + FDT surcharges \%)}\end{array}}$$

4. Step 3: Approximate Acquisition Cost Process

Step 3 converts full replacement cost to approximate acquisition cost.

<u>Step 3.1</u> This step calculates the inventory turn over ratio (ITOR) for both insurance and replenishment material. The proposed NAVSUP model then uses the ITOR to determine the approximate average age of the inventory. Equation 11 calculates the ITOR by dividing the value of inventory at standard price by annual sales.

Equation 11

$$\text{Approximate Average Age of Inventory} = \text{ITOR} = \frac{\text{Value of Inventory At Standard Price}}{\text{Annual Sales}}$$

If the approximate average age of the inventory is greater than 1 year, then the inventory's annual receipts must be processed through the IPDs in Steps 3.2 through 3.4 to determine the approximate acquisition cost of the inventory. In the unlikely event that annual sales were so high that the average age of the inventory becomes 1 year or less, then Steps 3.2 through 3.4 are skipped, and approximate acquisition cost is the full replacement cost from Step 1.

<u>Step 3.2</u> This step identifies the IPDs that will convert full replacement cost to approximate acquisition

costs for those budget projects with inventory older than one year. The proposed NAVSUP model processes all insurance material (regardless of budget project) through the DoD Procurement Appropriation IPD (DoD IPD). In addition, the proposed NAVSUP model processes replenishment material through separate IPDs generated specifically for each budget project (i.e., Budget Project 14 material is processed through the Budget Project 14 IPD). NAVSUP develops these budget project IPDs from price information available from the procurement contract. Table 6 illustrates how the proposed NAVSUP model uses five different IPDs for the various categories of material.

TABLE 6
PROPOSED NAVSUP MODEL COST PROCESS
ASSIGNMENT OF IPDS

Budget Project	Insurance Material Processed Through	Replenishment Material Processed Through
BP 14	DoD IPD	BP 14 IPD
BP 34	DoD IPD	BP 34 IPD
BP 81	DoD IPD	BP 81 IPD
BP 85	DoD IPD	BP 85 IPD

In Chapter I the thesis made two hypotheses. The second hypothesis addressed the use of a Navy Stock Fund IPD which would improve the calculation of approximate acquisition costs. The research model will replace the DoD

Procurement Appropriation IPD with a Navy Stock Fund IPD produced by the Bureau of Economic Analysis.

Step 3.3 This step determines how the inventory was received each fiscal year (FY) over the average age of the inventory. The assumption is made that the inventory was received in equal dollar increments over the age of the inventory. Equation 12 calculates the estimated annual receipts by dividing full replacement cost from Step 1 by the approximate age of the inventory from Step 3.1.

Equation 12

$$\text{Estimated Annual Receipts} = \frac{\text{Full replacement cost}}{\text{Approx. Avg. Age of Inventory}}$$

The assumption is made that 20 years is representative of the average life span of a weapons system, and therefore the oldest material in the inventory should not exceed 20 years. If in Step 3.1 annual sales are so low that the approximate average age of the inventory exceeds 20 years, the proposed NAVSUP model limits the material receipt period to 20 years and divides the full replacement cost by 20 to determine the estimated annual receipts.

Finally, the assumption is made that the production lead time for material is two years. Therefore, material received in any FY was priced and procured two years prior

to the date of receipt. Material received in the current FY provides the exception to this rule. The proposed NAVSUP model assumes that material received in the current year was received at the current FY replacement price.

Step 3.4 This step determines the approximate acquisition cost of inventory. Approximate acquisition cost estimates how many current year dollars are needed to acquire an asset and transport it to the initial storage depot in the year in which the asset was procured. Equation 13 calculates the approximate acquisition cost by dividing the appropriate compounded IPD into the estimated annual receipts for each year in the life of the inventory determined in Step 3.3.

Equation 13

$$\text{Approximate Acquisition Cost} = \sum \left[\frac{\text{Estimated Annual Receipts}}{(1 + \text{Annual IPD Compounded})} \right]$$

5. **Lower of Cost Or Market Decision Point**

This is the critical lower of cost or market decision point. Compare market value from Step 2 against approximate acquisition cost from Step 3, and proceed to Step 4 using the lower of either cost or market value.

6. **Step 4: "Condition" Value Process**

Taking the lower of cost or market value, Step 4 considers the "utility" and "serviceability" of the material to determine "condition" value.

Step 4.1 This step applies two distinct sets of stratification percentage matrices to the value derived from the lower of cost or market decision point. One matrix is for insurance material; the other is for replenishment material. With these matrices the cost or market value from Step 4 is divided into smaller and more meaningful components.

NAVSUP generates these separate matrices from headquarters-level summary stratification reports showing the inventory posture within each budget project. With this matrix insurance material is subdivided into "serviceable" material, "unserviceable" material, and stocking objectives. Likewise, replenishment material is subdivided into these three categories.

The following hypothetical example explains how stratification factors are developed. Assume that the summary stratification reports show that Budget Project 81 has a total inventory value of $30,000 which includes $18,000 of insurance material and $12,000 of replenishment material. These reports stratify these inventory values into the following categories.

Inventory Value By Strata

	Insurance Serviceable	Insurance Unserviceable	Replenishment Serviceable	Replenishment Unserviceable
AFAO	$3,600	$1,800	$1,200	$2,400
AFRS	3,000	1,500	1,200	2,400
ERS	2,700	900	600	1,200
CRS	1,800	900	600	1,200
NRS	000	000	000	000
PE	900	900	000	1,200
Total	$12,000	$6,000	$3,600	$8,400

Total Insurance Material	$18,000
Total Replenishment Material	$12,000
Total Material	$30,000

The total dollar value of insurance material ($18,000) is divided into two smaller components, serviceable ($12,000) and unserviceable material ($6,000). Both serviceable insurance and unserviceable insurance material consist of six dollar values for a total of 12. Each of these 12 dollar values for insurance material is divided by the total dollar value for insurance material, or $18,000. The quotient gives the percentage for each of these 12 insurance material categories. Likewise, each of the 12 dollar values for replenishment material is divided by the total dollar value for replenishment material, or $12,000. The resulting matrix of stratification percentages appears as the following:

Stratification Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	20.0%	10.0%	10.0%	20.0%
AFRS	16.6%	8.3%	10.0%	20.0%
ERS	15.0%	5.0%	5.0%	10.0%
CRS	10.0%	5.0%	5.0%	10.0%
NRS	0.0%	0.0%	0.0%	0.0%
PE	5.0%	5.0%	0.0%	10.0%
Total	66.6%	33.3%	30.0%	70.0%

With this matrix that was generated from summary reports, the value from the lower-of-cost-or-market decision point is subdivided into 24 separate numbers.

Step 4.2 This step considers the asset's "utility," which is a measure of the material's usefulness. [3] This step is the only part of the proposed NAVSUP model that is not a part of the 1990 model.

NSF classifies the degree of "utility" by stocking objectives (AFAO, AFRS, ERS, CRS, NRS or PE). An asset has 100% "utility" if it can be placed in one of five stocking objectives that justify the inclusion of the material in the Navy Stock Fund (AFAO, AFRS, ERS, CRS, or NRS).

If the asset is classified as Potential Excess (PE), then the asset's "utility" is its salvage value, or the amount of cash that the asset can generate through the

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[3] It is necessary to make a distinction between utility and "utility." Utility without the quotation marks refers to the definition of market value in Chapter II. "Utility" with the quotation marks refers to Step 4.2 of the NAVSUP model and its consideration of the material's usefulness.

disposal process. Recent experience has shown that the disposal process returns an average of $2.90 for every $100 at standard price of PE material sold. Consequently, Step 4.2 would use a "utility" percentage of 2.9% for PE material. Material stratified to all other categories is valued at 100%. Equation 14 calculates the material's "utility" value.

Equation 14

$$\text{"Utility" Value} = \Sigma\ (\text{Stratified Lower of Cost or Market Values from Step 4.1} \times \text{"Utility" Percentages})$$

<u>Step 4.3</u> In this step the value of the inventory is reduced by the average cost of repairs needed to bring all of the assets within a budget project to a fully useable state. "Serviceable" material is material that requires no repairs and therefore is stated at 100% of its replacement cost. "Unserviceable" describes material that requires repairs, and its value must be reduced by the average amount of repairs needed to bring the asset to a fully useable state.

Summary stratification reports provide the dollar value of material in "serviceable" and "unserviceable" categories. This procedure is similar to the procedure in Step 4.1. However, the resulting percentages indicate the

proportion of material in the insurance material category by stocking objective that is in either "serviceable" or "unserviceable" condition. The same procedure would be applied to replenishment material.

Equation 15 computes inventory at the "condition" value. In the proposed NAVSUP model the "condition" value is the final inventory value.

Equation 15

$$\text{"Condition" Value} = \Sigma\ (\text{"Utility" Values from Step 4.2}\ \times\ \text{Serviceability Percentages})$$

E. PROPOSED NAVSUP MODEL NUMERIC EXAMPLE

This section illustrates the proposed NAVSUP model using an example. Using strictly hypothetical data, the example was designed to convey a clear understanding of how the proposed NAVSUP model functions. All figures are stated in 1000's, and are rounded up to the nearest whole number. Consequently, rounding may lead to inconsistencies in totals.

1. Step 0: Obtain NRFC FIR Data

Start with a hypothetical end-of-fiscal year 1990 inventory balance at standard price for Budget Project 81.

Value of Inventory at Standard Price $10,891

2. Step 1: Full Replacement Cost Process

Step 1.1 Determine the replacement cost of the inventory. The total surcharge is 10.0%, therefore replacement cost is $9,901.

Value of Inventory at Standard Price	$10,891
Divide by Total Surcharge Percentage	1.10
Equals Replacement Cost	$9,901

Step 1.2 Determine full replacement cost by multiplying replacement cost by the FDT surcharge percentage. The FDT surcharge is 1%.

Replacement Cost	$9,901
Multiply by the FDT Surcharge Percentage	1.01
Equals Full Replacement Cost	$10,000

Assume that insurance material represents 60% of full replacement cost, and replenishment material represents the other 40%. Therefore, separate figures for insurance and replenishment material are calculated:

Full Replacement Cost	$10,000
Multiplied by Insurance Material Percentage	X 60%
Equals Full Replacement Cost/ Insurance Material	$6,000

Full Replacement Cost	$10,000
Multiplied by Replenishment Matl Percentage	X 40%
Equals Full Replacement Cost/ Replenishment Material	$4,000

3. Step 2: Market Value Process

Equation 10 demonstrated that market value is the same figure as full replacement cost. Therefore, market value is also $10,000 consisting of $6,000 insurance material and $4,000 replenishment material.

4. Step 3: Approximate Acquisition Cost Process

Step 3.1 This step calculates the ITOR and the approximate average age of inventory for both insurance and replenishment material. First, the inventory at standard price must be split into insurance and replenishment categories.

	Insurance	Replenishment
Inventory at Standard Price	$10,891	$10,891
Multiply by the Material %	60%	40%
Equals Material's Value at Standard Price	6,534.7	$4,356.4

Now divide the material's value at standard price by the annual sales figure.

	Insurance	Replenishment
Material's Value at Standard Price	$6,534.7	$4,356.4
Divide by Annual Sales At Standard Price	$625.0	$1,875.0
Equals Inventory Turn Ratio	10.5	2.3
Equals the Approximate Age of Inventory	10.5 years	2.3 years

Since the approximate ages of both insurance and replenishment inventory are both greater than 1 year, the full replacement cost from Step 1 must be processed through the IPDs in Step 3, Steps 3.2 through 3.4 to determine the approximate acquisition cost of the inventory.

Step 3.2 The proposed NAVSUP model uses separate IPDs for insurance and replenishment material. The DoD

Procurement Appropriation IPD will convert the full replacement cost of insurance material to approximate acquisition cost, and the Budget Project 81 IPD will convert the full replacement cost of replenishment material to approximate acquisition cost. The annual rates of both of these IPDs are shown below. Positive figures indicate price inflation. Negative figures represent price deflation.

FY	DoD IPD	Budget Project 81 IPD
1988	3.97%	-11.5%
1987	3.66%	-15.57%
1986	3.22%	-11.03%
1985	3.07%	-1.47%
1984	3.35%	1.85%
1983	4.41%	7.58%
1982	6.24%	11.98%
1981	8.28%	15.10%
1980	10.13%	13.10%
.	.	.
.	.	.

Step 3.3 This step calculates a flow of inventory receipts that are of equal size over the age of the inventory. Insurance and replenishment material figures are computed separately. The hypothetical example for insurance material shows that estimated annual receipts of $573.9 over a ten year period does not add to an even $6,000, and a remainder of $261.4 exists. This remainder is assumed to have been received in the next fiscal year.

Insurance

Full Replacement Cost	$6,000
Divided by the Approximate Avg. Age of the Inventory	10.5 years
Equals Estimated Annual Receipts	$573.9 per year

			DoD Procurement IPD	
FY Received	FY Contracted	Value	Annual	Compounded
1990	1988	$573.9	3.97%	3.97%
1989	1987	$573.9	3.66%	7.78%
1988	1986	$573.9	3.22%	11.23%
1987	1985	$573.9	3.07%	14.67%
1986	1984	$573.9	3.35%	18.50%
1985	1983	$573.9	4.41%	23.74%
1984	1982	$573.9	6.24%	31.45%
1983	1981	$573.9	8.28%	42.33%
1982	1980	$573.9	10.13%	56.76%
1981	1979	$573.9	10.20%	72.76%
1980	1978	$261.4	9.75%	89.56%
Total Insurance Material		$6,000.0		

Replenishment

Full Replacement Cost	$4,000
Divided by the Approximate Avg. Age of the Inventory	2.3 years
Equals Estimated Annual Receipts	$1,721.6 per year

			DoD Procurement IPD	
FY Received	FY Contracted	Value	Annual	Compounded
1989	1988	$1,721.6	-11.52%	-11.52%
1988	1987	$1,721.6	-15.57%	-25.30%
1987	1986	$556.8	-11.03%	-33.54%
Total Replenishment Matl		$4,000.0		

Step 3.4 This step determines the approximate acquisition cost of the inventory. The annual receipts determined in Step 3.3 are stated at current year full

replacement cost, and are divided by (1 + compounded IPD factors) to approximate acquisition cost.

Insurance

FY	Received	Compounded IPD Factor	Approx. Acquis. Cost
1990	$573.9	3.97%	$551.9
1989	$573.9	7.78%	$532.5
1988	$573.9	11.23%	$515.9
1987	$573.9	14.67%	$500.5
1986	$573.9	18.50%	$484.3
1985	$573.9	23.74%	$463.8
1984	$573.9	31.45%	$436.6
1983	$573.9	42.33%	$403.2
1982	$573.9	56.76%	$366.1
1981	$573.9	72.76%	$332.2
1980	$261.4	89.56%	$138.0
Total	$6,000.0		$4,725.0

Replenishment

FY	Value Received	Compound IPD Factor	Approx. Acquis. Cost
1989	$1,721.6	-11.52%	$1,945.7
1988	$1,721.6	-25.30%	$2,304.6
1987	$556.8	-33.54%	$837.7
Total	$4,000.0		$5,088.0

Total Insurance Material:	$4,725
Total Replenishment Material	$5,088
Inventory at approximate acquisition cost:	$9,813

5. Lower of Cost or Market Decision Point

In order to determine the lower of cost or market value, compare market value from Step 2 with the approximate acquisition cost from Step 3.

	Approx. Acquis. Cost	Market Value
Total	$9,813	$10,000

Select the approximate acquisition cost of $9,813 and proceed to Step 4.

6. Step 4: Final Inventory Values

Step 4.1 Apply the stratification percentages to the approximate acquisition cost of $9,813. In this example fabricated stratification percentages were used.

Stratification Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	20.0%	10.0%	20.0%	10.0%
AFRS	15.0%	10.0%	20.0%	5.0%
ERS	15.0%	5.0%	10.0%	5.0%
CRS	10.0%	5.0%	10.0%	5.0%
NRS	0.0%	0.0%	0.0%	0.0%
PE	5.0%	5.0%	10.0%	5.0%
Total	65.0%	35.0%	70.0%	30.0%

Inventory Value By Strata

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$945	$473	$1,018	$509
AFRS	709	473	1,018	254
ERS	709	236	509	254
CRS	473	236	509	254
NRS	0	0	0	0
PE	236	236	509	254
Total	$3,072	$1,654	$3,562	$1,525

Note that the stratification percentages have not changed the total dollar value of the inventory since the decision point at Step 4.

Total Insurance Material:	$4,725
Total Replenishment Material:	$5,088
Inventory at approximate acquisition cost:	$9,813

<u>Step 4.2</u> Determine the "utility" value of the stratified inventory from Step 4.1. The assumption is made that the average proceeds from the disposal process are a hypothetical 3% ($3 returned for every $100 of material at standard price disposed of).

<u>"Utility" Factors</u>

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	100.0%	100.0%	100.0%	100.0%
AFRS	100.0%	100.0%	100.0%	100.0%
ERS	100.0%	100.0%	100.0%	100.0%
CRS	100.0%	100.0%	100.0%	100.0%
NRS	100.0%	100.0%	100.0%	100.0%
PE	3.0%	3.0%	3.0%	3.0%

Inventory At "Utility" Value

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$945	$473	$1,018	$509
AFRS	709	473	1,018	254
ERS	709	236	509	254
CRS	473	236	509	254
NRS	0	0	0	0
PE	7	7	15	7
Total	$2,843	$1,425	$3,069	$1,278

Total Insurance Material: $4,268

Total Replenishment Material: $4,347

Inventory at "Utility" Value: $8,615

Step 4.3 In this step, the material condition of the inventory within the budget project is considered, and the inventory value from "utility" value is reduced to "condition" value.

Unserviceable Condition Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	100.0%	50.0%	100.0%	50.0%
AFRS	100.0%	50.0%	100.0%	50.0%
ERS	100.0%	50.0%	100.0%	50.0%
CRS	100.0%	50.0%	100.0%	50.0%
NRS	100.0%	50.0%	100.0%	50.0%
PE	100.0%	50.0%	100.0%	50.0%

Inventory At "Condition" Value

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$945	$237	$1,018	$255
AFRS	709	237	1,018	127
ERS	709	118	509	127
CRS	473	118	509	127
NRS	0	0	0	0
PE	7	4	15	4
Total	$2,843	$714	$3,069	$640

Total Insurance Material:	$3,557
Total Replenishment Material:	$3,709
Inventory at "Condition" Value:	$7,266

7. Summary Of Inventory Valuation Process

Table 7 summarizes the nine values produced by the proposed NAVSUP model. In the proposed NAVSUP model "condition" value is always the final inventory value.

TABLE 7
SUMMARY OF THE
VALUES PRODUCED BY
THE PROPOSED NAVSUP MODEL

Standard Price	$10,891
Replacement Cost	$9,901
Full Replacement Cost	$10,000
Market Value	$10,000
Approx. Acquisition Cost	$9,813
Lower of Cost or Market	$9,813
"Utility" Value	$8,615
"Condition" Value	$7,266
Final Inventory Value	$7,266

F. CONCLUSION

This chapter described the proposed NAVSUP model. The computations in the proposed NAVSUP model were illustrated using a hypothetical numerical example. In this example the proposed NAVSUP model chose approximate acquisition cost at the decision point, and calculated a final inventory value of $7,266.

V. THE RESEARCH MODEL

A. INTRODUCTION

This chapter argues for two modifications to the proposed NAVSUP model, and incorporates these modifications into the research model. The first modification changes the sequence in which the proposed NAVSUP model calculates final inventory values. "Utility" and "serviceability" from Step 4 in the proposed NAVSUP model are moved and incorporated into the market value process.

The second modification incorporates an alternative IPD into the cost process found in Step 3 of the proposed NAVSUP model. This chapter will argue that at the Department of Commerce the Bureau of Economic Analysis (BEA) produces a Navy Stock Fund IPD (BEA NSF IPD) that has several advantages over the DoD Procurement Appropriation IPD.

This chapter will first identify the strengths of the proposed NAVSUP model, which includes an explanation why the proposed NAVSUP model is correct to consider the "utility" and "serviceability" of the material during the inventory valuation process. The discussion will then state the reasons for incorporating "utility" and "serviceability" into the market value process.

The chapter will also build the case for the BEA NSF IPD to replace the DoD Procurement Appropriation IPD, and list the advantages and disadvantages. After these arguments are made, a hypothetical numeric example illustrating the research model will be shown. This numeric example will use the same figures as the numeric example that was processed through the proposed NAVSUP model in Chapter IV.

B. FEATURES OF THE PROPOSED NAVSUP MODEL THAT COMPLY WITH THE LCM ACCOUNTING PRINCIPLE

The strength of the proposed NAVSUP model is that Step 1 immediately calculates CRC, which the proposed NAVSUP model calls full replacement cost. This feature complies with the LCM accounting principle's definition of market value as utility measured primarily by CRC. Starting with standard price, Step 1 stripped standard price of all surcharges to arrive at replacement cost. FDT charges were capitalized into the replacement cost to represent the cost of conveying the material to its initial storage depot. The final result of this step is called was full replacement cost. Consequently, full replacement cost represents both the cost of replacement and the cost of transportation to its initial storage depot, and quantifies the current cost to replace the material.

The NAVSUP model also links CRC and full replacement cost to market value. Equation 10 shows that market value

from Step 2 is set equal to full replacement cost from Step 1. Equation 16 demonstrates that in the proposed NAVSUP model CRC, full replacement cost and market value are an equality, which is consistent with the definition of market value from Chapter II:

Equation 16

$$\boxed{\text{CRC} = \text{Full Replacement Cost} = \text{Market Value}}$$

Therefore, the proposed NAVSUP model makes a conscientious effort to comply with the spirit of the LCM accounting principle.

In addition, the proposed NAVSUP model considers the "serviceability" and "utility" into the inventory valuation process. "Serviceability" captures that portion of the total inventory within a budget project held at or in transit to the repair depot, and reduces the inventory by the average amount of repairs necessary to bring the asset to a ready-for-issue condition.

1. "Serviceability" In The Proposed NAVSUP Model

This thesis concurs with the proposed NAVSUP model's consideration of "serviceability" as a factor affecting the value of the inventory. The LCM accounting principle measured market value by using the utility of the material, which could be impaired by damage, deterioration, or

obsolescence [Ref. 2:p. 27,521]. "Serviceability" recognizes that the utility of the material has been impaired by damage and deterioration, and reduces the value of the material by the average cost of repairs.

If a NSF inventory valuation model ignores the "serviceability" of NSF material, then NSF managers can value damaged and deteriorated material according to two alternatives, both of which are unacceptable. First, the value of DLR material that is impaired and in transit to the depot level repair facility could be reduced to zero. However, this completely ignores the asset's residual value, even if the material is in a state of disrepair. This would drastically understate inventory values.

A second alternative would be to value the inventory at its full replacement cost. However, this would ignore the asset's utility when it is impaired by damage and deterioration and would violate the spirit of the LCM accounting principle. Although the LCM accounting principle does not explicitly provide for the "serviceability" of material, its inclusion in the inventory valuation process avoids a gross overstatement and understatement of inventory values. The thesis argues that "serviceability" complies with the spirit of the LCM accounting principle.

a. GAO Support For Consideration Of "Serviceability"

In 1990, the GAO assailed Air Force accounting procedures for ignoring "serviceability" in the inventory valuation process. The GAO stated in their 1990 audit on Air Force financial statements:

> Inventory values are not adjusted for the condition of the items in the inventory. Although about $7 billion (over 50%) of the investment-item inventory at three [Air Logistic Centers] - Ogden, San Antonio, and Warner Robbins - was unserviceable, it was valued the same as new inventory items. This practice significantly overstates inventory values and is misleading because the true inventory value is less than the amount shown and because there is a substantial additional cost to bring unserviceable items to a useable condition [Ref 11:p. 65].

The GAO also stated that the "failure to consider and report the cost or repair is not acceptable for financial management" [Ref. 11:p. 66], and concluded:

> The Air Force needs to develop a methodology which regularly adjusts the unserviceable portion of its inventory to reflect the costs associated with repairing these items [Ref. 11:p. 66].

The GAO recommended that the Air Force "establish a policy to value unserviceable items to reflect the estimated cost of repair" [Ref. 11:p. 71]. DoD concurred with this recommendation [Ref. 11:p. 71].

2. "Utility" In The Proposed NAVSUP Model

The proposed NAVSUP model is also correct to consider "utility" as a factor affecting the value of the inventory. If parts become obsolete, then the LCM accounting principle requires the inventory's market value to reflect

the reduction in utility due to obsolescence [Ref. 2:p. 27,521].

Certain repair parts and components bought to support a particular weapon system may be unique only to the military. When a weapon system is retired or modified, repair parts designed to support this particular weapon system may become obsolete. No market may exist for material with stringent and uniquely military specifications. The technology incorporated into the material may also be obsolete. Again, two alternatives exist. Obsolete material may be valued at full replacement cost. However, this would violate the spirit of the LCM accounting principle.

The other alternative is to value obsolete material at zero. However, a markdown to zero would ignore the proceeds from the disposal process. Therefore, the thesis argues that the proposed NAVSUP model is correct to value PE material at its "utility," or the salvage value to be realized from the disposal process.

C. ARGUMENTS FOR MODIFICATIONS TO THE SEQUENCE TO THE PROPOSED NAVSUP MODEL

While the proposed NAVSUP model is correct to consider "serviceability" and "utility," this thesis argues that these two components should be incorporated into the market valuation process in the proposed NAVSUP model. Figure 4

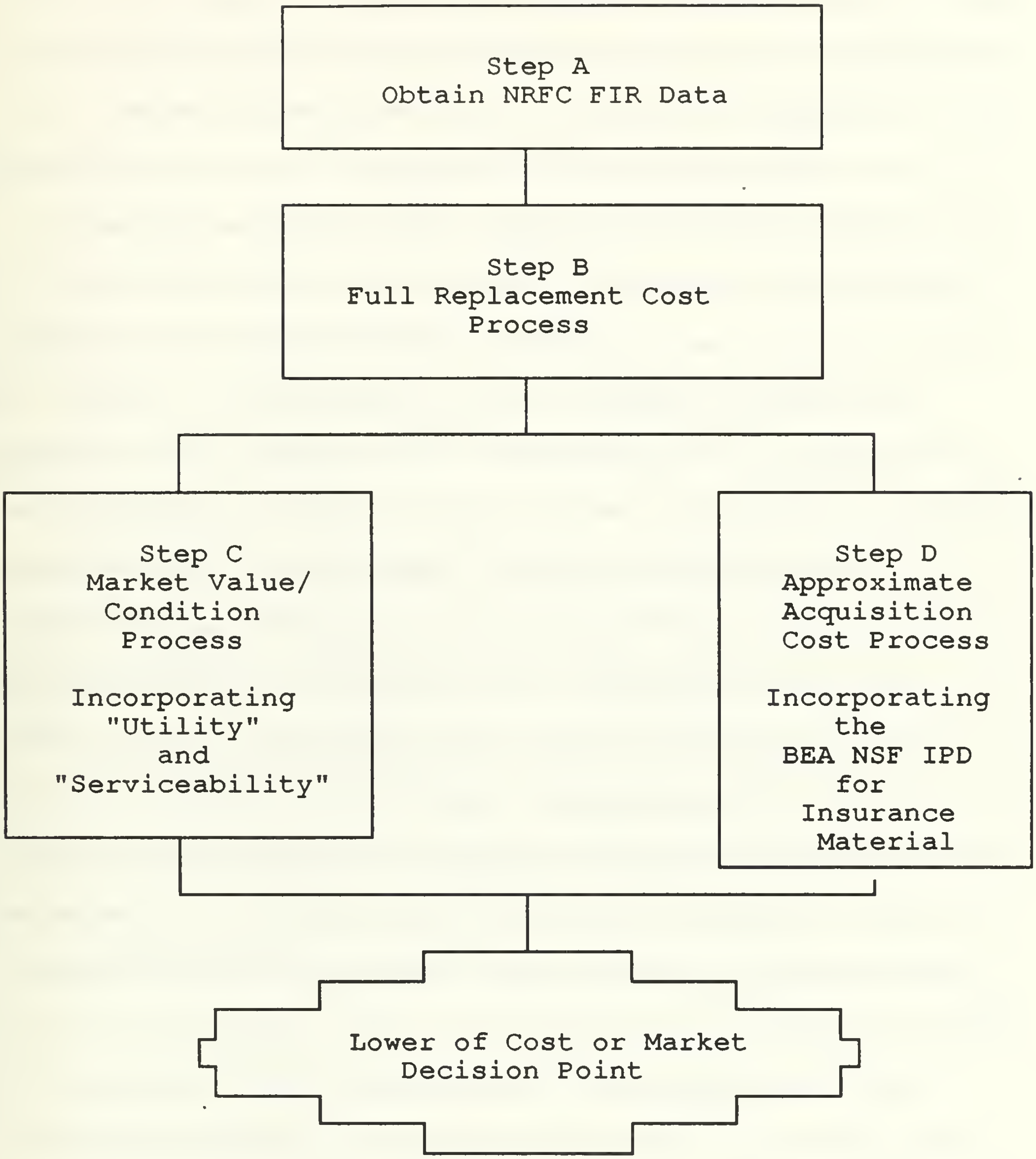


Figure 4
Research Model
Determination of Final Inventory Values By Budget Project

shows that the research model incorporates "serviceability" and "utility" into the market valuation process, and consequently the lower of cost or market decision point is the last step in the model. Since the research model considers "utility" and "serviceability" in the market value process, the output from Step C will be called market/condition value. Figure 4 also shows that in Step D the research model uses the BEA NSF IPD for insurance material.

Two arguments support the consideration of "utility" and "serviceability" in the market value process. First, market value is broadly defined as utility [Ref. 2:p. 27,525]. If utility is impaired by damage, deterioration, obsolescence, or other causes [Ref. 2:p. 27,525], then the amount of the loss should be reflected in the material's selling price and ultimately in the material's NRV, which is a critical part of the market value process. Since "serviceability" in Step 4.2 measured the amount of damage and deterioration, and "utility" in Step 4.3 measured obsolescence of PE material, a NSF inventory valuation model should incorporate these steps into the market process.

There is an additional argument why "utility" and "serviceability" should be considered during the market value process. In the discussion of the LCM accounting principle, the LCM decision table showed that the procedure to determine market value is a subjective process. The determination of market value requires a judgment of an

anticipated future value to be realized if an item is sold (NRV) and an anticipated future price to be paid if an item is acquired (CRC). In contrast, the procedure to determine cost requires verification of actual costs expended in past transactions, and is usually objective. Even when circumstances dictate that costs be estimated subjectively, the intent is that cost measures the amount of resources expended in an actual past transaction.

Figure 5 illustrates the key concepts of the LCM accounting principle in the flow chart for the research model. Figure 5 shows a market value process that is future-oriented and a cost process that is oriented on past transactions. "Utility" and "serviceability" relate to estimates of future exit values, and consideration of "utility" and "serviceability" helps in measuring NRV.

For example, "serviceable" material requires the expenditure of money for repairs after which the NSF would be able to sell this asset at full standard price. The "serviceability" percentages measure the estimated net proceeds (standard price less the cost of repairs) from the future sale of the material, and quantify the NRV of reparable material. PE material must be sold through the disposal market, and the disposal market determines the asset's salvage value. The "utility" percentages measure the estimated proceeds from the future sale of PE material, and

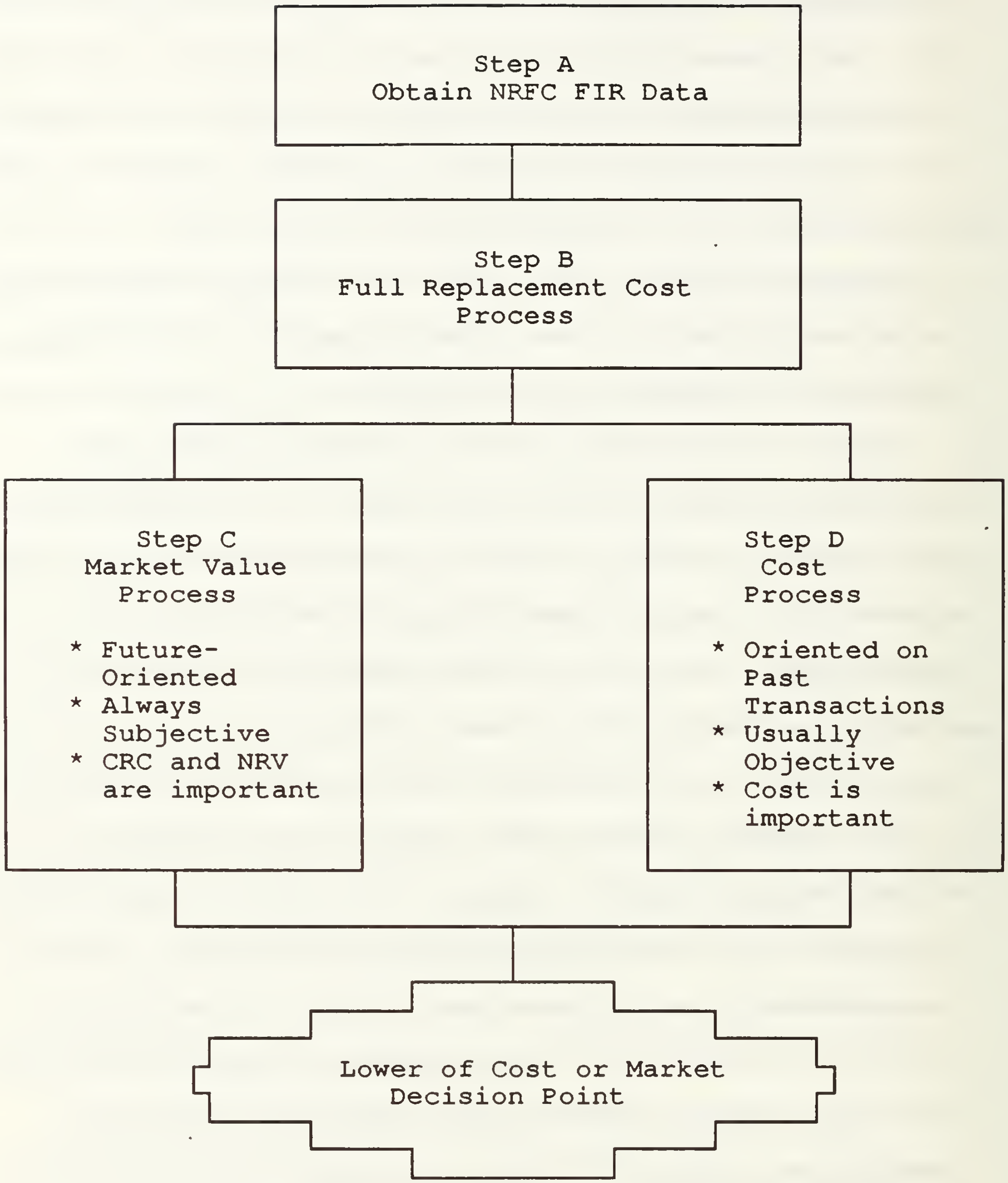


Figure 5
Flow Chart of
The Research Model
Showing The Distinctions Between
The Market Value Process
And
The Cost Process

determine the NRV for PE material. Since "serviceability" and "utility" relate to NRV, it is appropriate to incorporate them into the market valuation process.

D. NAVY STOCK FUND IMPLICIT PRICE INDICES

Only one IPD accurately measures price changes for insurance material and should be used in the cost process. However, an IPD that measures only insurance material does not exist. In the absence of the ideal insurance material IPD, the task is to identify an IPD that is the best possible alternative.

The proposed NAVSUP model uses the DoD Procurement Appropriation IPD for insurance material. However, the DoD Procurement Appropriation IPD has two major shortcomings that make it an inappropriate IPD for insurance material. First, the DoD Procurement Appropriation IPD measures the change in prices for principal items such as weapons, equipment, munitions, and modifications to existing equipment, as well as for high-priced secondary items and spare parts. Therefore, the DoD Procurement Appropriation IPD is not an accurate measure of just NSF insurance material.

Second, the DoD Procurement Appropriation IPD includes the effects of price changes experienced by the Army, Air Force, Navy and Marine Corps. Therefore, this IPD will reflect price changes experienced in, for example, Army tank

and Air Force fighter procurement actions, which have no relationship to price changes experienced in Navy insurance material procurement actions.

At the U.S. Department of Commerce, the Bureau of Economic Analysis produces an IPD based on NSF purchases. There are four arguments for using the BEA NSF IPD for insurance material.

The BEA NSF IPD is specific to the NSF, and that alone is a distinct advantage over the DoD Procurement Appropriation IPD. The second advantage is that the BEA uses information from the four budget projects that this thesis is researching. Navy Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania, procures and manages the material in budget projects 14 and 81. Navy Aviation Supply Office (ASO), Philadelphia, Pennsylvania performs the same functions for the material in budget projects 34 and 85. Both SPCC and ASO provide contract cost information to BEA on computer tapes from their "Contract History File" and "Contract Status File" [Ref. 14:p. 123]. The BEA then uses this information to calculate the NSF BEA IPD.

The third advantage is that the NSF BEA IPD uses price changes from two of the three major sources of insurance material for the NSF. Insurance material may enter the NSF from:

1. The purchase by ASO and SPCC of material classified as insurance material;

2. The purchase by ASO and SPCC of material classified as replenishment material, and due to demand for this replenishment material decreasing to less than four demands a year the material is reclassified as insurance material;

3. The purchase by a major Navy systems command (Naval Air Systems Command or Naval Sea Systems Command) of material for the interim support period of a major weapons system; after the interim support period this material is transferred to the NSF and capitalized as insurance material [Ref. 15].

The BEA NSF IPD gets the price changes from purchases made by ASO and SPCC, and thus contains data from the first two sources of insurance material.

Finally, the BEA NSF IPD is selective in the transactions that it includes. It includes only purchases from the private sector at the wholesale level, which would include insurance material. The BEA NSF IPD does not include intra-DoD purchases and retail fund purchases which would not typically include insurance material [Ref. 14:pp. 115 and 122] .

There are, however, three distinct problems with the BEA NSF IPD. First, the BEA NSF IPD includes price changes from both insurance and replenishment material purchases, and may be biased by the large number of replenishment material procurement actions. Due to a high level of demand, replenishment material frequently experiences multiple procurement actions which may lead to price increases or decreases depending on inflation, quantity discount,

learning curve effects, and/or increased competition among vendors.

Second, the BEA NSF IPD includes purchases of secondary material in addition to Budget Projects 14, 34, 81 and 85. ASO and SPCC purchase material for other budget projects, and not just Budget Projects 14, 34, 81, and 85. The price changes associated with these other budget projects will be included in the computer tapes that ASO and SPCC send to BEA. Consequently, the BEA NSF IPD includes the price changes from other budget projects, and will measure cost growth across a multiple number of budget projects.

Third, the BEA NSF IPD will not capture the price changes associated with the purchase of insurance material by major Navy systems commands. Since ASO and SPCC have no responsibility for these procurement actions, the price information will not be included on the computer tapes sent to BEA.

This thesis has presented the arguments that the BEA NSF IPD is the best measure of cost growth for insurance material. However, the use of the BEA NSF IPD will require one exceptional difference in how the cost process calculates approximate acquisition costs. The proposed NAVSUP model made the assumption that 20 years was representative of the average life span of a weapons system, and therefore the oldest insurance material in the inventory would not exceed 20 years. The proposed NAVSUP model used

the DoD Procurement Appropriation IPD which covered more than 20 years of price changes and thus could accommodate this assumption.

The BEA NSF IPD, however, is a relatively new IPD, and only covers 16 years. Therefore, the research model will limit the age of the inventory to a maximum of 16 years versus the 20 year limit used in the proposed NAVSUP model.

Figures 6 and 7 show cost growth measured by the BEA NSF IPD, the DoD Procurement Appropriation IPD and the four budget project IPDs. Figure 6 shows that the BEA NSF IPD and the DoD Procurement Appropriation IPD have similar trends and indicate a steady rate of inflation. On the other hand, the three budget project IPDs (Budget Projects 14, 34 and 81) in Figure 6 show a steady rate of deflation over the past five to seven years. Figure 6 shows 1981 constant dollars since the Budget Project 81 IPD for replenishment material only goes as far back as 1981.

Figure 7 shows the Budget Project 85 IPD with the BEA NSF IPD and the DoD Procurement Appropriation IPD. The Budget Project 85 IPD also shows a steady rate of deflation in the past six years. Figure 7 reflects 1985 constant dollars since the Budget Project 85 IPD starts in 1985.

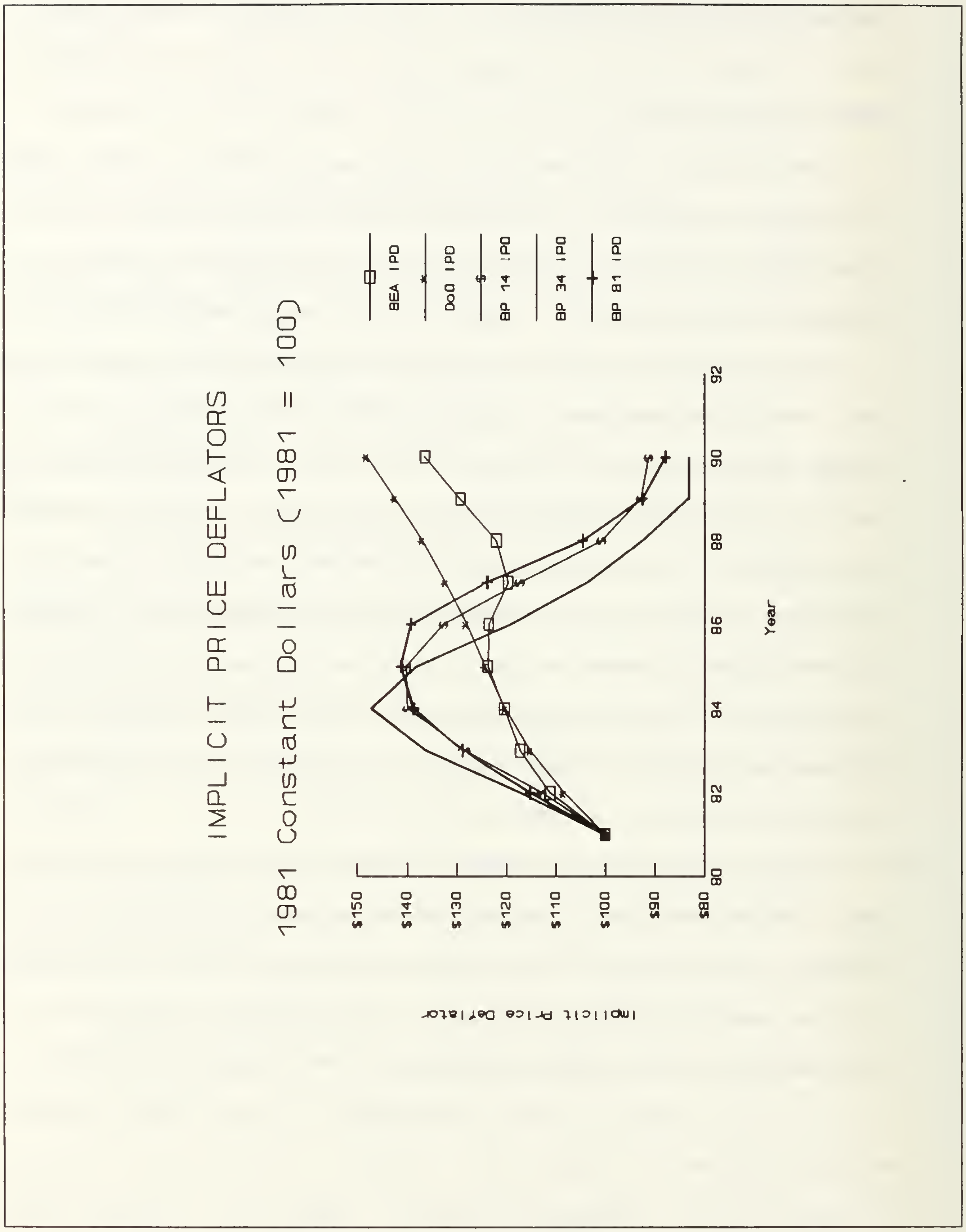

IMPLICIT PRICE DEFLATORS
1981 Constant Dollars (1981 = 100)
Implicit Price Deflator
$150
$140
$130
$120
$110
$100
$90
$80
80
82
84
86
88
90
92
Year
BEA IPD
DoD IPD
BP 14 IPD
BP 34 IPD
BP 81 IPD

Figure 6

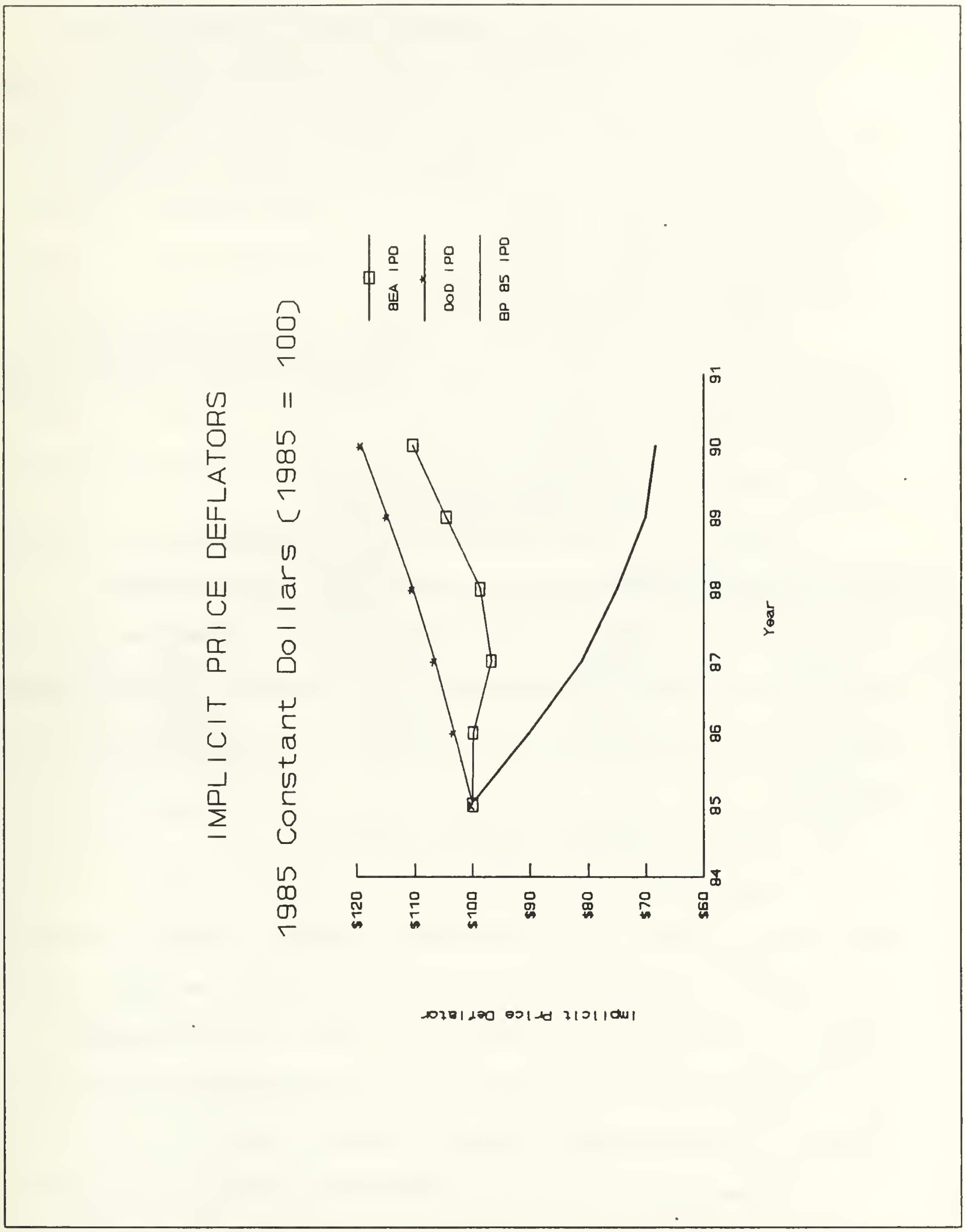

IMPLICIT PRICE DEFLATORS
1985 Constant Dollars (1985 = 100)
Implicit Price Deflator
$120
$110
$100
$90
$80
$70
$60
84
85
86
87
88
89
90
91
Year
BEA IPD
DoD IPD
BP 85 IPD

Figure 7

E. RESEARCH MODEL NUMERIC EXAMPLE WITH THE BEA NSF IPD

This section is similar to Section E of Chapter IV where hypothetical data was processed through the proposed NAVSUP model. The identical hypothetical data will be processed through the research model.

1. Step A: Obtain FIR Data

Step A is identical to Step 0 in the NAVSUP model. Step A obtains the value of the inventory at standard price from the NRFC FIR reports.

2. Step B: Full Replacement Cost

Step B in the research model is identical to Step 1 in the proposed NAVSUP model. The value of inventory at standard price begins at $10,891. Step B, therefore, calculates a full replacement cost of $10,000, consisting of $6000 of insurance material and $4000 of replenishment material.

3. Step C: Market/Condition Value

This step identifies market value as full replacement cost. As in the NAVSUP example, market value is $10,000, and consists of $6,000 of insurance material and $4,000 of replenishment material. Step C also considers "serviceability" and "utility", and subsequently the final output is called market value/condition value.

Step C.1 This step is similar to Step 4.1 in the proposed NAVSUP model. Starting with an input value of full

replacement cost and a 60%/40% mixture of insurance/ replenishment material, this step applies a matrix of stratification factors to both the insurance and replenishment material categories. The stratification factors are the same as in the example computations used in Step 4.1 of the proposed NAVSUP model. However, in the research model these stratification factors are applied to the market value of $10,000. The proposed NAVSUP model applied them to the approximate acquisition cost of $9,813 from the lower-of-cost-or-market decision point.

Stratification Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	20.0%	10.0%	20.0%	10.0%
AFRS	15.0%	10.0%	20.0%	5.0%
ERS	15.0%	5.0%	10.0%	5.0%
CRS	10.0%	5.0%	10.0%	5.0%
NRS	0.0%	0.0%	0.0%	0.0%
PE	5.0%	5.0%	10.0%	5.0%
Total	65.0%	35.0%	70.0%	30.0%

Inventory Value By Strata

	Insurance Serviceable	Insurance Unserviceable	Replenishment Serviceable	Replenishment Unserviceable
AFAO	$1,200	$600	$800	$400
AFRS	900	600	800	200
ERS	900	300	400	200
CRS	600	300	400	200
NRS	0	0	0	0
PE	300	300	400	200
Total	$3,900	$2,100	$2,800	$1,200

Total Insurance: $6,000 Total Replenishment: $4,000

Inventory at Market Value $10,000

Step C.2 This step considers the "utility" of the material, and is the same procedure as Step 4.2 in the proposed NAVSUP model.

"Utility" Factors

	Insurance Serviceable	Insurance Unserviceable	Replenishment Serviceable	Replenishment Unserviceable
AFAO	100.0%	100.0%	100.0%	100.0%
AFRS	100.0%	100.0%	100.0%	100.0%
ERS	100.0%	100.0%	100.0%	100.0%
CRS	100.0%	100.0%	100.0%	100.0%
NRS	100.0%	100.0%	100.0%	100.0%
PE	3.0%	3.0%	3.0%	3.0%

Inventory at "Utility" Values

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$1,200	$600	$800	$400
AFRS	900	600	800	200
ERS	900	300	400	200
CRS	600	300	400	200
NRS	0	0	0	0
PE	9	9	12	6
Total	$3,609	$1,809	$2,412	$1,006

Total Insurance: $5,418 Total Replenishment: $3,418

Inventory at Market/Utility Value: $8,836

Step C.3 This step is the same procedure as Step 4.3 in the proposed NAVSUP model, and considers the condition of the material.

"Serviceability" Condition Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	100.0%	50.0%	100.0%	50.0%
AFRS	100.0%	50.0%	100.0%	50.0%
ERS	100.0%	50.0%	100.0%	50.0%
CRS	100.0%	50.0%	100.0%	50.0%
NRS	100.0%	50.0%	100.0%	50.0%
PE	100.0%	50.0%	100.0%	50.0%

Inventory Value By Strata

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$1,200	$300	$800	$200
AFRS	900	300	800	100
ERS	900	150	400	100
CRS	600	150	400	100
NRS	0	0	0	0
PE	9	5	12	3
Total	$3,609	$905	$2,412	$503

Total Insurance: $4,514 Total Replenishment: $2,915

Inventory at Market Value/Condition $7,429

4. Step D: Approximate Acquisition Cost

These steps calculate the approximate acquisition cost of the inventory, and are similar to Step 3 in the proposed NAVSUP model. However, the research model uses the BEA NSF IPD in the place of the DoD Procurement Appropriation IPD.

Step D.1 This step calculates the ITOR and the approximate age of inventory for both insurance and replenishment material, and is the same as Step 3.1 in the proposed NAVSUP model. Therefore, the maximum age of insurance material is 10.5 years, and the maximum age of replenishment material is 2.3 years.

Step D.2 The research model uses separate IPDs for both insurance and replenishment material. The BEA NSF IPD will convert the full replacement cost of insurance material to approximate acquisition cost, and the Budget Project 81 IPD will convert the full replacement cost of replenishment material to approximate acquisition cost. The annual rates for the BEA NSF IPD and the Budget Project 81 IPD are shown below.

FY	BEA NSF IPD	Budget Project 81 IPD
1988	5.96%	-11.5%
1987	2.01%	-15.57%
1986	-3.17%	-11.03%
1985	-0.13%	-1.47%
1984	2.76%	1.85%
1983	2.72%	7.58%
1982	5.33%	11.98%
1981	11.21%	15.10%
1980	10.87%	13.10%
.	.	.
.	.	.

Step D.3 This step is the same as Step 3.3 in the proposed NAVSUP model, and determines how the current inventory was received each FY over the age of the inventory. Insurance and replenishment material figures are conducted separately.

Insurance

Full replacement cost	$6,000
Divided by the Approximate Age of the Inventory	10.5 years
Equals Estimated Annual Receipts	$573.9 per year

FY Received	FY Contracted	Value	BEA NSF IPD Annual	BEA NSF IPD Compounded
1990	1988	$573.9	5.96%	5.96%
1989	1987	$573.9	2.01%	8.10%
1988	1986	$573.9	-3.17%	4.67%
1987	1985	$573.9	-0.13%	4.54%
1986	1984	$573.9	2.76%	7.43%
1985	1983	$573.9	2.72%	10.34%
1984	1982	$573.9	5.33%	16.22%
1983	1981	$573.9	11.21%	29.26%
1982	1980	$573.9	10.87%	43.30%
1981	1979	$573.9	8.81%	55.91%
1980	1978	$261.4	9.46%	70.63%
Total Insurance Material		$6,000.0		

Replenishment

Full replacement cost	$4,000
Divided by the Approximate Age of the Inventory	2.3 years
Equals Estimated Annual Receipts	$1,721.6 per year

FY Received	FY Contracted	Value	NAVSUP BP 81 IPD Annual	Compounded
1989	1988	$1,721.6	-11.52%	-11.52%
1988	1987	$1,721.6	-15.57%	-25.30%
1987	1986	$556.8	-11.03%	-33.54%
Total Replenishment Matl.		$4,000.0		

Step D.4 This step is the same as NAVSUP Step 3.4, and determines the approximate acquisition cost of the inventory. The annual receipts determined in Step D.3 are stated at current year full replacement cost, and must be converted by the IPDs to approximate acquisition cost.

Insurance

FY	Value Received	Compound IPD Factor	Approx. Acquis. Cost
1990	$573.9	5.96%	$541.6
1989	$573.9	8.10%	$530.9
1988	$573.9	4.67%	$548.3
1987	$573.9	4.54%	$549.0
1986	$573.9	7.43%	$534.2
1985	$573.9	10.34%	$520.1
1984	$573.9	16.22%	$493.8
1983	$573.9	29.26%	$444.0
1982	$573.9	43.30%	$400.5
1981	$573.9	55.91%	$368.1
1980	$261.4	70.63%	$153.2
Total	$6,000.0		$5,083.8

Replenishment

FY	Value Received	Compound IPD Factor	Approx. Acquis. Cost
1989	$1,721.6	-11.52%	$1,945.7
1988	$1,721.6	-25.30%	$2,304.6
1987	$556.8	-33.54%	$837.7
Total	$4,000.0		$5,088.0

Total Insurance Material:	$5,084
Total Replenishment Material	$5,088
Inventory at approximate acquisition cost:	$10,172

5. Lower of Cost or Market Value Decision Point

In determining the lower of cost or market, the research model uses the same procedure as the proposed NAVSUP model. However, market value in the research model already reflects the "utility" and "serviceability" of the material.

Lower of Cost or Market
Decision Point

	Approx. Acquis. Cost	Market "Condition"
Total	$10,172	$7,429

6. Summary of inventory valuation process

Table 8 summarizes the nine outputs from the research model. In the research model the lower of cost or market value is the final inventory value.

TABLE 8
RESEARCH MODEL

Value at Standard Price	$10,891
Replacement Cost	$9,901
Full Replacement Cost	$10,000
Market Value	$10,000
Market Value/"Utility"	$8,836
Market Value/"Condition"	$7,429
Approximate Acquisition Cost	$10,172
Lower of Cost or Market Value	$7,429
Final Inventory Value	$7,429

F. CONCLUSION

The proposed NAVSUP model has features that comply with the LCM accounting principle, and is correct to consider the "utility" and "serviceability" of NSF material. However, the research model improves upon the degree of compliance with this accounting principle by incorporating "utility" and "serviceability" into the market value process. The research model also incorporates a different IPD into the cost process. This may provide a better approximation of acquisition cost since the BEA NSF IPD is created from data that contains a higher percentage of NSF purchases than does the DoD Procurement Appropriation IPD.

The research model processed the same hypothetical raw data that was processed through the proposed NAVSUP model in Chapter IV. The research model produced a final inventory value of $7,429 which was greater than that produced by the

proposed NAVSUP model ($7,266). In these examples the difference in final inventory values can be attributed to two factors, the research model's consideration of the "utility" and "serviceability" during the market valuation process and the use of the BEA NSF IPD.

VI. RESEARCH METHODOLOGY AND DATA PRESENTATION

A. INTRODUCTION

This chapter will explain the research methodology, and address each of the four subsidiary questions. Section B will describe intervening variables, identify the research model as the standard for final inventory values, and define the measurements. Section B will also discuss the sensitivity analysis.

In Section C the actual data for Fiscal Year 1990 will be used, and both the proposed NAVSUP model and the research model will be allowed to calculate final inventory values that would have been reported in the fiscal year 1990 financial reports.

In Sections D through F sensitivity analysis techniques will be used to determine how final inventory values produced by the proposed NAVSUP and research models fluctuate with increases in three intervening variables.

B. RESEARCH METHODOLOGY

1. Research Methodology And Intervening Variables

When the proposed NAVSUP and research models processed the identical hypothetical data as an example in Chapters IV and V, the two models produced different final inventory values. Since both examples used identical hypothetical data, these examples led to the conclusion that the choice to use one or the other of these two models will affect final inventory values.

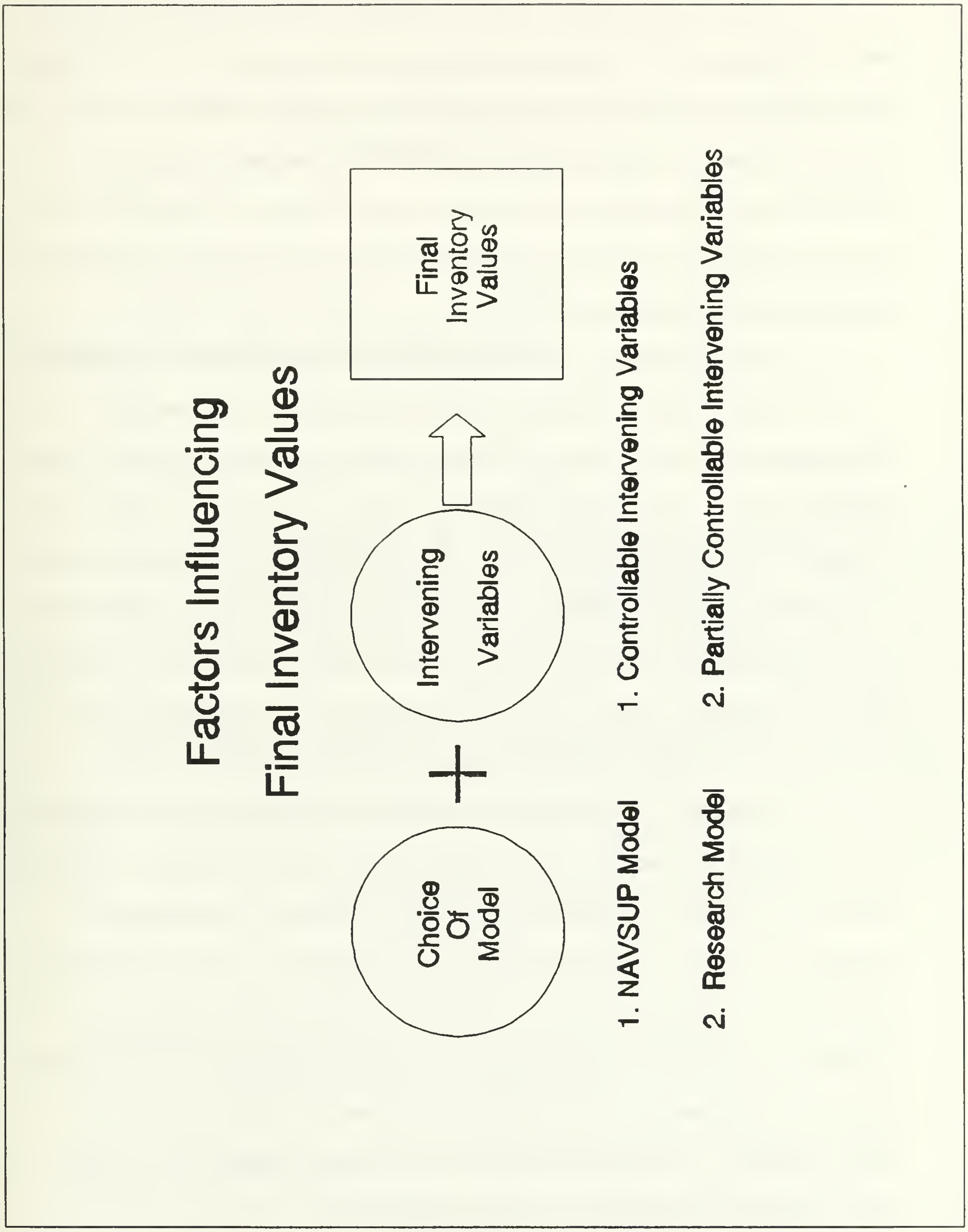
However, other factors besides the choice of an inventory valuation model will affect final inventory values. In the proposed NAVSUP and research models, intervening variables can also influence the final inventory value. For instance, the value of annual sales or the percentage of insurance material are two examples of intervening variables. The term "intervening variable" is used here to refer to all other variables within the valuation models that affect final inventory values. These variables "intervene" in the sense that the value of these variables may influence the degree to which the final inventory values produced by the proposed NAVSUP and the research models differ from each other. If these intervening variables increase or decrease, the proposed NAVSUP and research models will produce different final inventory values. Therefore, the choice of an inventory valuation

model and changes in the intervening variables are the two major factors that determine final inventory values. Figure 8 illustrates this association between the choice of an inventory valuation model, changing intervening variables and final inventory values.

The thesis classifies the intervening variables into two major categories. The first category contains intervening variables over which NSF management exercises significant control. For instance, NSF management determines the annual surcharge percentage and the FDT surcharge percentage. Consequently, these two intervening variables are called "controllable." The second category includes intervening variables that are influenced more by daily operations. The NSF management exercises partial or little control over these intervening variables, and these variables are called "partially controllable." Examples of partially controllable intervening variables are:

1. Annual sales;
2. The value of inventory at standard price;
3. The percentages of insurance/replenishment material;
4. Stratification percentages;
5. "Utility" and "serviceability" factors.

A change in any one of these partially controllable variables could impact the final inventory values produced by the proposed NAVSUP and research models.



Factors Influencing
Final Inventory Values
Choice Of Model
+
Intervening Variables
Final Inventory Values
1. NAVSUP Model
2. Research Model
1. Controllable Intervening Variables
2. Partially Controllable Intervening Variables

Figure 8

Three partially controllable intervening variables were selected for study. These were the value of inventory at standard price, the percentage of insurance material and annual sales of the material within a budget project. Sensitivity analysis techniques were used to determine how final inventory values fluctuate with increases in these three intervening variables.

2. Justification For The Three Intervening Variables

The value of inventory at standard price was selected for two reasons. First, the proposed NAVSUP model begins the valuation process in Step 0 with the value of inventory at standard price. As the value of inventory at standard price increases, full replacement cost increases. Full replacement cost is then the input value into Steps 2 and 3. Figure 9 shows how an increase in standard price leads to a ripple effect in the proposed NAVSUP model.

Second, an analysis based on the value of inventory at standard price captures the effect of all other variables from the start to the end of the inventory valuation process. Third, a NSF manager is familiar with financial inventory reports that provide a dollar value for the inventory at standard price, and can easily correlate the value of inventory at standard price as the unit of measurement in NSF financial inventory reports with the intervening variable in this research.

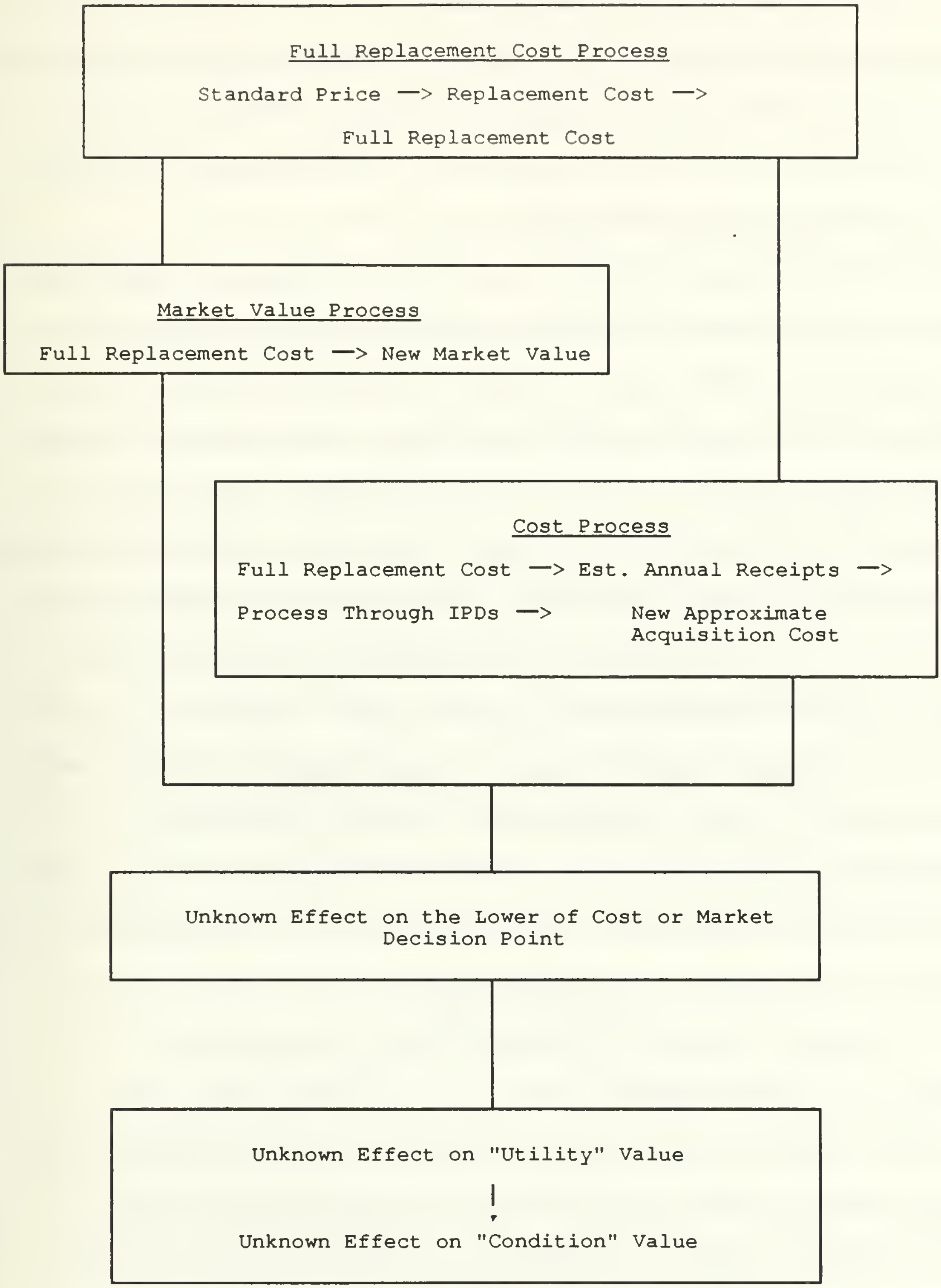


Figure 9
Ripple Effect Of A Change In
The Amount of Inventory At Standard Price
In The Proposed NAVSUP Model

The percentage of insurance material was selected as the second intervening variable. For any budget project, the stratification process divides the value of inventory at standard price into two components, a) insurance material, and b) replenishment material.

Each budget project can have a different insurance/ replenishment from the other budget projects. The NAVSUP spreadsheets show Budget Project 14 with a 61%/39% mix of insurance and replenishment material, respectively. On the other hand, Budget Project 85 had a 33%/67% mix. The purchase and receipt of material during the course of normal business from one fiscal year to another can alter this mix.

It is anticipated that the mix of insurance and replenishment material will affect final inventory values for two reasons. First, Step 3 in the proposed NAVSUP model and Step D in the research model process the value of insurance and replenishment material through different IPDs to determine approximate acquisition cost. Consequently, the mix will determine how many dollars of the inventory are to be processed through the insurance IPD and the remaining dollars to be processed through the replenishment IPD. Second, Step 4 in the proposed NAVSUP model and Step C in the research model respectively process insurance and replenishment material through different "utility" and "serviceability" percentages. The insurance material mix will determine how many dollars are to be processed through

the insurance material's "utility" and "serviceability" percentages and how many dollars are to be processed through the replenishment material's "utility" and "serviceability" percentages.

Finally, annual sales was chosen as the third intervening variable. Annual sales is a critical component in the process to determine approximate acquisition cost in Step 3 of the proposed NAVSUP model and Step D in the research model. For example, if the proposed NAVSUP model held all other variables constant and doubled annual sales, the age of the inventory would be halved. The ripple effect through Steps 3 and D is best demonstrated in Figure 10:

Annual Sales X 2 —> $\frac{\text{Age of Inventory}}{2}$ —>

Estimated Annual Receipts X 2 —> IPDs —>

Unknown Effect on Approximate Acquisition Cost

Figure 10
Ripple Effect of
Annual Sales
In The Proposed NAVSUP And Research Models

Since the age of the inventory is halved, both the proposed NAVSUP model and the research models assume that the material was received at twice the rate (in dollar value) for each of the fiscal years. Doubling annual sales therefore leads to an inventory with half the age and twice

the dollar value received each fiscal year. It is anticipated that altering annual sales will ultimately lead to an approximate acquisition cost that will influence the outcome from the decision point in both the proposed NAVSUP model and the research model.

3. The Standard

The analysis will measure the final inventory values produced by the proposed NAVSUP model against those produced by the research model. The measurements of accuracy and bias will treat final inventory values from the research model as the baseline, and determine how the proposed NAVSUP model values inventory in comparison to the research model. Subsection 5 will identify the measures of accuracy and bias.

4. Graphs and Analysis

Graphs will present how final inventory values from both models change in response to increasing increments in the intervening variable. The analysis will compare final inventory values from the proposed NAVSUP model against those produced from the research model, and interpret the results considering bias, accuracy, and materiality.

5. Definitions

Bias represents the tendency of the proposed NAVSUP model to understate or overstate the final inventory values relative to the research model. The analysis will measure

bias as the differences (measured in dollars) in final inventory values from the proposed NAVSUP model expressed as a percentage of the final inventory values from the research model.

"FIV/R" designates the final inventory values of the research model, and "FIV/N" designates the final inventory values of the proposed NAVSUP model. Equation 17 illustrates how the research will measure bias:

Equation 17
Bias

$$\frac{FIV/N-FIV/R}{FIV/R}$$

Equation 18 calculates the mean of bias across several observations. "N" represents the number of observations made of final inventory values in either model.

Equation 18
Mean of the Bias

$$\frac{\sum\left(\frac{FIV/N-FIV/R}{FIV/R}\right)}{N}$$

Measures of bias that are negative values indicate that the proposed NAVSUP model is understating final

inventory values in comparison to the research model. Measures of bias that are positive values indicate the proposed NAVSUP model is overstating final inventory values in comparison to the research model.

Assessing bias is useful to see if the proposed NAVSUP model produces final inventory values that are on average overstated or understated. It is possible for the proposed NAVSUP model to produce individual final inventory values that are sometimes overstated and sometimes understated, but not on average biased.

Two new equations determine accuracy. The research defines accuracy as the absolute value of the difference in final inventory values between the two models expressed as a percentage of the final inventory values from the research model. The measurement of the absolute value of the differences in final inventory values eliminates the canceling out of overstatements and understatements that can occur when bias measures are averaged. Both overstatements and understatements are treated equally as absolute errors. Accuracy will gauge how precisely the proposed NAVSUP model produces final inventory values in comparison to the research model. Both the range of these percentages and the mean of these percentages will be investigated.

Equation 19 calculates accuracy at any given point. Consideration of accuracy values across several observations will permit assessment of the range of accuracy:

Equation 19
Accuracy

$$\left|\frac{FTV/N-FTV/R}{FTV/R}\right|$$

Equation 20 calculates the mean of the accuracy, or the average percentage over several observations.

Equation 20
Mean of Accuracy

$$\frac{\sum\left|\frac{FTV/N-FTV/R}{FTV/R}\right|}{N}$$

A critical aspect of accuracy and bias is materiality. The differences between final inventory values will be considered material when they exceed 10% of the research model's value. The analysis will identify the range over which the intervening variable produces material differences between the two models. This range will be provided in a table, and identified in the graphs with darkened boxes.

6. Sensitivity Analysis Procedure

A range of final inventory values will be calculated in each of the four budget projects, and calculate the amount of bias and the degree of accuracy in each budget project. Graphs will display the final inventory values from each budget project. The analysis will add the final inventory values from all four budget projects to determine the cumulative final inventory value. Collectively, answers to the four subsidiary questions will permit the research to conclude whether the proposed NAVSUP model creates final inventory values that are materially different from those produced in the research model.

The scope of the sensitivity analysis was limited to a comparison of the proposed NAVSUP model against the research model. Recall that the research model differs from the proposed NAVSUP model due to two changes, the incorporation of "utility" and "serviceability" into the market valuation process and the use of the BEA NSF IPD in the place of the DoD Procurement Appropriation IPD. One could of course create a model by making only one, and not both of these changes to the proposed NAVSUP model. This suggests that there are really four possible models and six

possible ways to compare those models with each other. Figure 11 summarizes the possibilities.

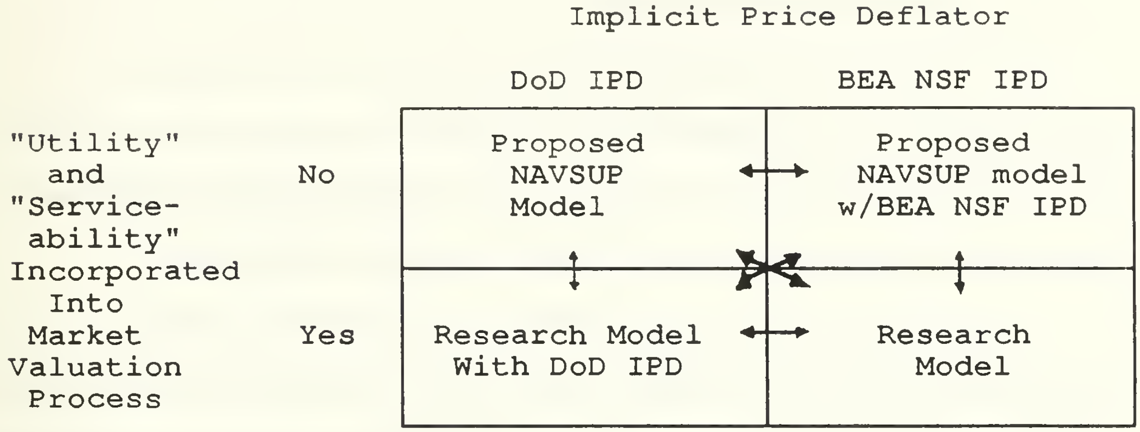


Figure 11
Structure of Possible Tests

The tests could be structured and conclusions could be drawn by investigating all six possible combinations. However, this approach would be cumbersome. Since both changes will be recommended (that the proposed NAVSUP model incorporate "utility" and "serviceability" into the market valuation process and that the proposed NAVSUP model use the BEA NSF IPD), the scope has been limited to a direct comparison of the proposed NAVSUP model against the research model.

C. SUBSIDIARY QUESTION NUMBER ONE

1. Subsidiary Question

The first subsidiary question asks, "Using Fiscal Year 1990 data and holding constant all other variables, does the proposed NAVSUP model create final inventory values

for Fiscal Year 1990 that are materially different from those produced in the research model?"

2. Research Methodology

This section uses the proposed NAVSUP model to calculate the cumulative final inventory value that would have been reported if the proposed NAVSUP model had been used for the Fiscal Year 1990 financial reports.

Using the same raw data, this section also determines what the cumulative final inventory value would have been if the research model had been used for the Fiscal Year 1990 financial reports. Two data tables compare these two values to show the differences between cumulative final inventory values produced by both models.

3. Data Presentation

Table 9 presents the proposed NAVSUP and research models' final inventory values for each budget project and the cumulative final inventory values. Table 10 shows the amount of bias and accuracy.

4. Analysis

For the 1990 financial reports the proposed NAVSUP model would have calculated cumulative final inventory values that overstated the value of the inventory in comparison to the research model. However, the average amount of bias and accuracy were 1.8%, and therefore no material differences exist.

Bias within individual budget projects, however, was widely divergent. Budget Project 85 overstated final inventory values by 5.5%, and Budget Project 14 understated final inventory values by (9.3%). However, the proposed NAVSUP model did not produce final inventory values for any budget project that were biased by a material amount.

Since this section calculated only single values for each budget project and not an average of values, the results for accuracy within each budget project are very similar to those of bias. The least accurate were Budget Projects 14 (9.3%) and Budget Project 85 (5.5%). However, the proposed NAVSUP model did not produce final inventory values in any budget project that were inaccurate by a material amount.

Altogether, the proposed NAVSUP model calculated a single final inventory value for four budget projects. During the calculations the proposed NAVSUP model chose approximate acquisition cost four times. In contrast, the research model chose market value four times.

TABLE 9
FINAL INVENTORY VALUES
FOR FISCAL YEAR 1990
(MILLIONS)

Budget Project	Proposed NAVSUP Model Fin. Invent. Value	Research Model Fin. Invent. Value
14	$1,523.4	$1,679.3
34	2,053.5	1,956.0
81	4,898.1	5,006.8
85	9,077.4	8,601.8
Cumulative	$17,552.3	$17,243.7

TABLE 10
BIAS AND ACCURACY

Budget Project	Bias	Accuracy
14	(9.3%)	9.3%
34	5.0%	5.0%
81	(2.2%)	2.2%
85	5.5%	5.5%
Average	1.8%	1.8%

D. SUBSIDIARY QUESTION NUMBER TWO

1. Subsidiary Question

The second subsidiary question asks, "Holding constant all other variables and increasing the value of inventory at standard price, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?"

2. Research Methodology

Holding constant all other variables, this section increases the value of inventory at standard price from zero to $10 billion in $500 million increments in both the proposed NAVSUP and research models, and determines the effect on final inventory values in the proposed NAVSUP and research models. Within each model the test is conducted separately by budget project, and the four budget projects are added to determine the cumulative final inventory values.

3. Data Presentation

Tables 11, 12 and 13 summarize the results from Figures 12 through 16. Tables 11 and 12 indicate the amount of bias and the range of the intervening variable which produces material differences in the proposed NAVSUP model. Table 13 shows how accurate the proposed NAVSUP model is.

Figure 12 shows how the increase in the value of inventory at standard price affects the cumulative final

TABLE 11
INFLUENCE OF THE VALUE OF INVENTORY
ON BIAS

Budget Project	Bias Range			Average Bias
BP 14	(3.7%)	to	(20.0%)	(11.7%)
BP 34	7.7%	to	(2.9%)	0.7%
BP 81	0.9%	to	(10.4%)	(4.1%)
BP 85	6.2%	to	(2.9%)	0.5%
Cumulative	0.4	to	(6.9%)	(3.7%)

TABLE 12
RANGE OF THE VALUE OF INVENTORY AT STANDARD PRICES
WHICH PRODUCE MATERIAL DIFFERENCES
IN THE PROPOSED NAVSUP MODEL

Budget Project	Value Of Inventory At Standard Price
BP 14	\$1.0 to \$2.0 Billion
BP 14	\$6.0 Billion and above
BP 81	\$2.0 Billion only

TABLE 13
INFLUENCE OF
THE VALUE OF INVENTORY AT STANDARD PRICE
ON ACCURACY

Budget Project	Accuracy Range			Average Accuracy
BP 14	3.7%	to	20.0%	11.7%
BP 34	0.0%	to	7.7%	1.3%
BP 81	0.9%	to	10.4%	4.2%
BP 85	0.1%	to	7.9%	1.3%
Cumulative	0.2	to	6.9%	3.7%

inventory values for both the proposed NAVSUP and research models. Figures 13 through 16 show how this intervening variable affects final inventory values individually for budget projects 14, 34, 81 and 85. Figures 13 through 16 indicate material differences between final inventory values with darkened boxes.

It is understood that "Standard Price" in the graphs means the value of inventory at standard price. Due to the limitations in the graphics program, the five graphs are only able to show "As A Function of Standard Price."

4. **Analysis**

Table 11 indicates that the proposed NAVSUP model produces final inventory values that are materially biased in Budget Project 14 only. The average of (11.7%) exceeds the 10% limit for materiality, and is a negative figure. Therefore, this indicates that Budget Project 14 is biased in understating final inventory values by a material amount. Table 12 supports this analysis, and shows that Budget Project 14 produces material differences in the ranges of $1 to $2 billion, and $6 billion and greater. The fact that Budget Project 14 has a bias range that is always negative suggests that this budget project always understates (and never overstates) final inventory values over the range of the intervening variable. There are no indications that any

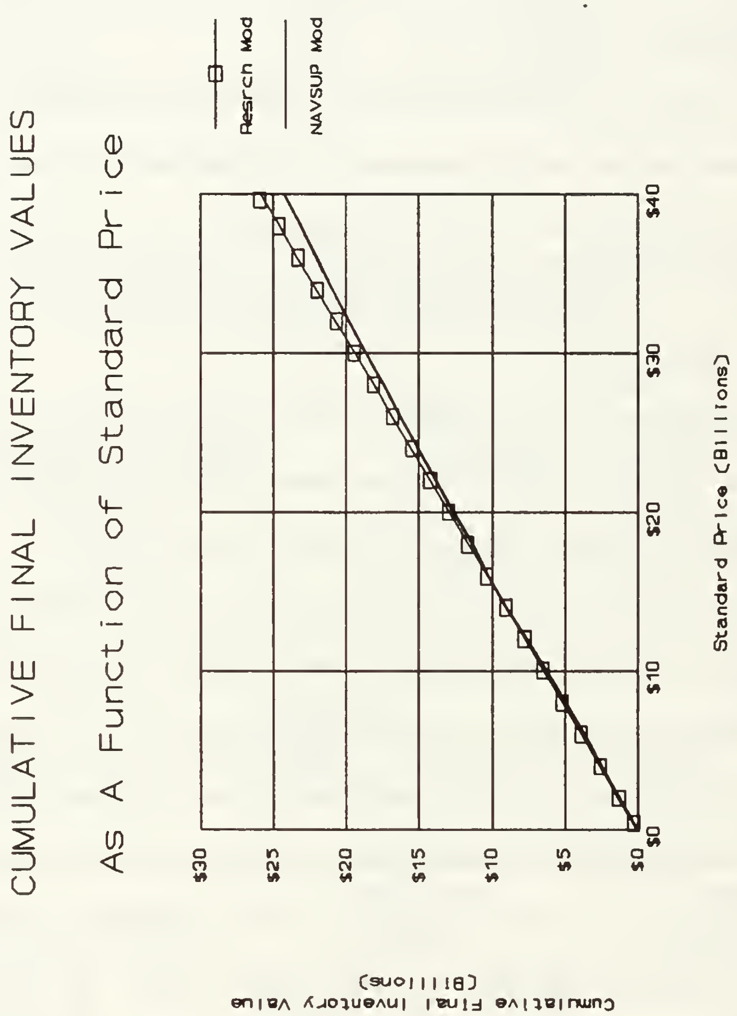

CUMULATIVE FINAL INVENTORY VALUES
As A Function of Standard Price
Resrch Mod
NAVSUP Mod
Cumulative Final Inventory Value (Billions)
$30
$25
$20
$15
$10
$5
$0
Standard Price (Billions)
$0
$10
$20
$30
$40

Figure 12

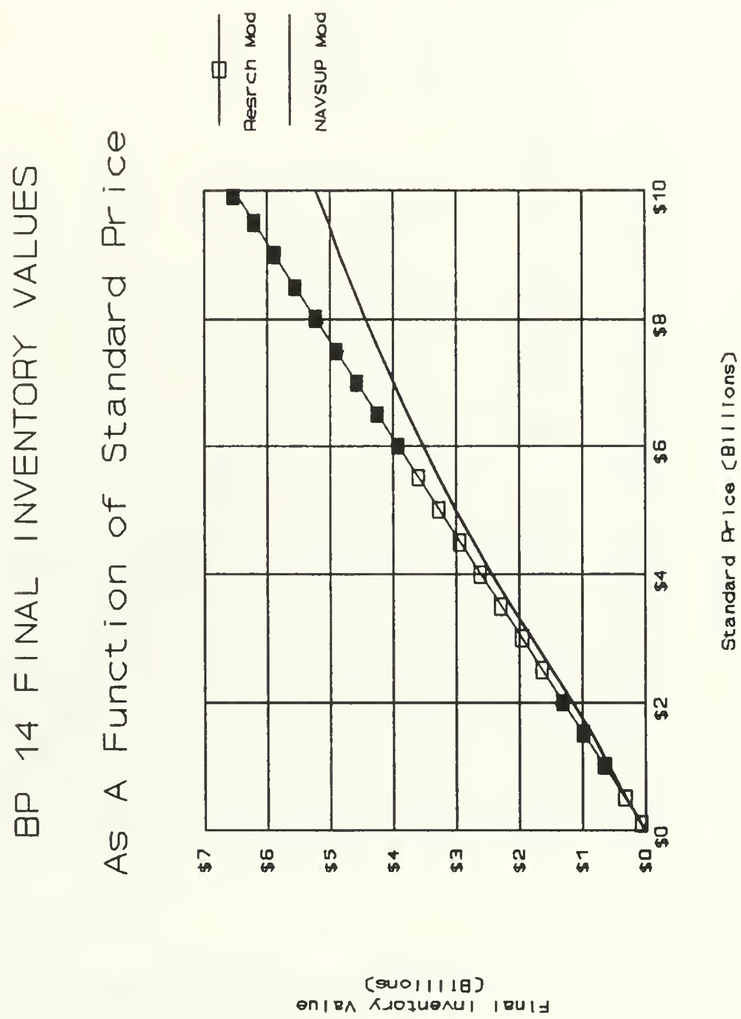

BP 14 FINAL INVENTORY VALUES
As A Function of Standard Price
Resrch Mod
NAVSUP Mod
Final Inventory Value (Billions)
$0
$1
$2
$3
$4
$5
$6
$7
$0
$2
$4
$6
$8
$10
Standard Price (Billions)

Figure 13

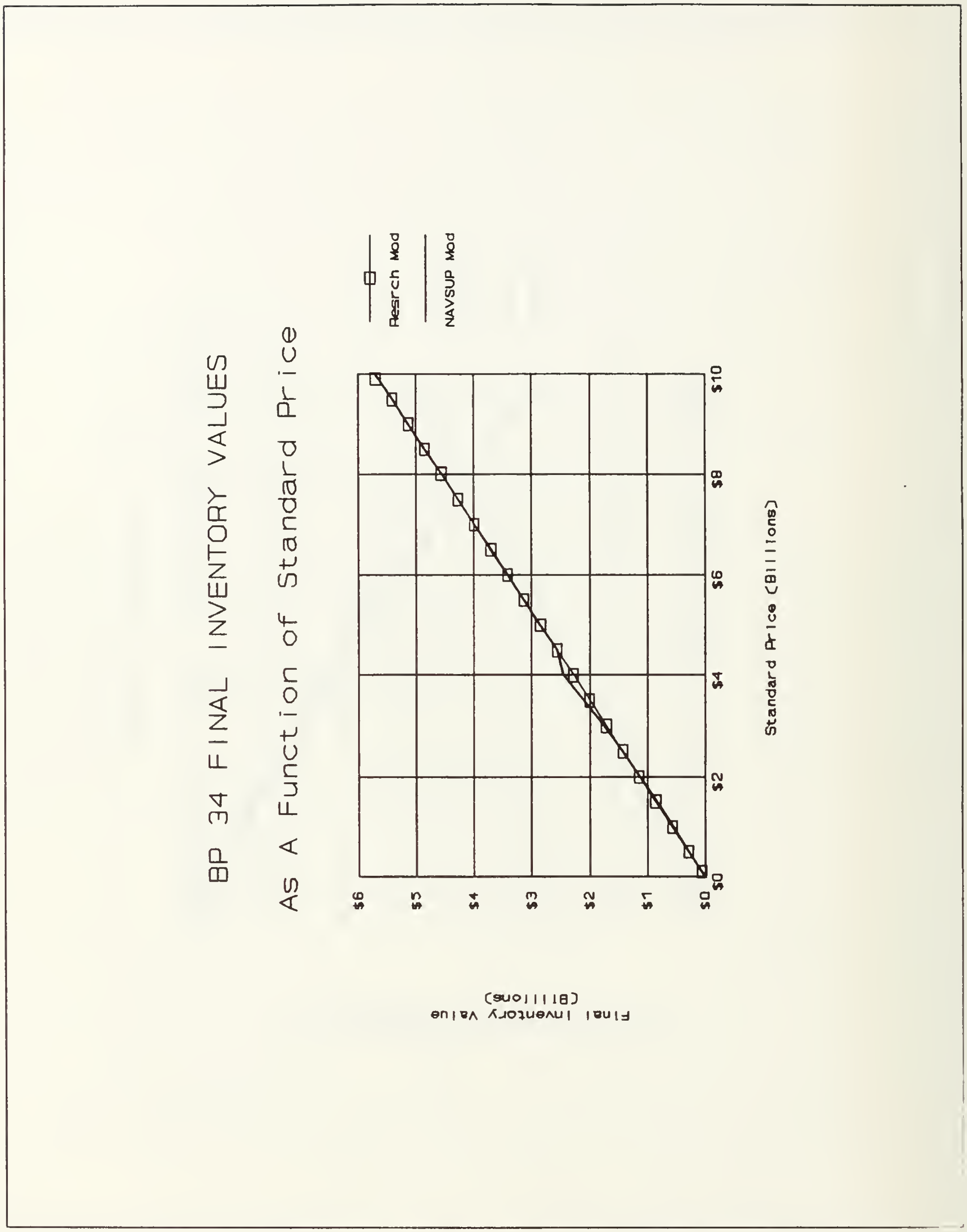

BP 34 FINAL INVENTORY VALUES
As A Function of Standard Price
Resrch Mod
NAVSUP Mod
Final Inventory Value
(Billions)
$0
$1
$2
$3
$4
$5
$6
Standard Price (Billions)
$0
$2
$4
$6
$8
$10

Figure 14

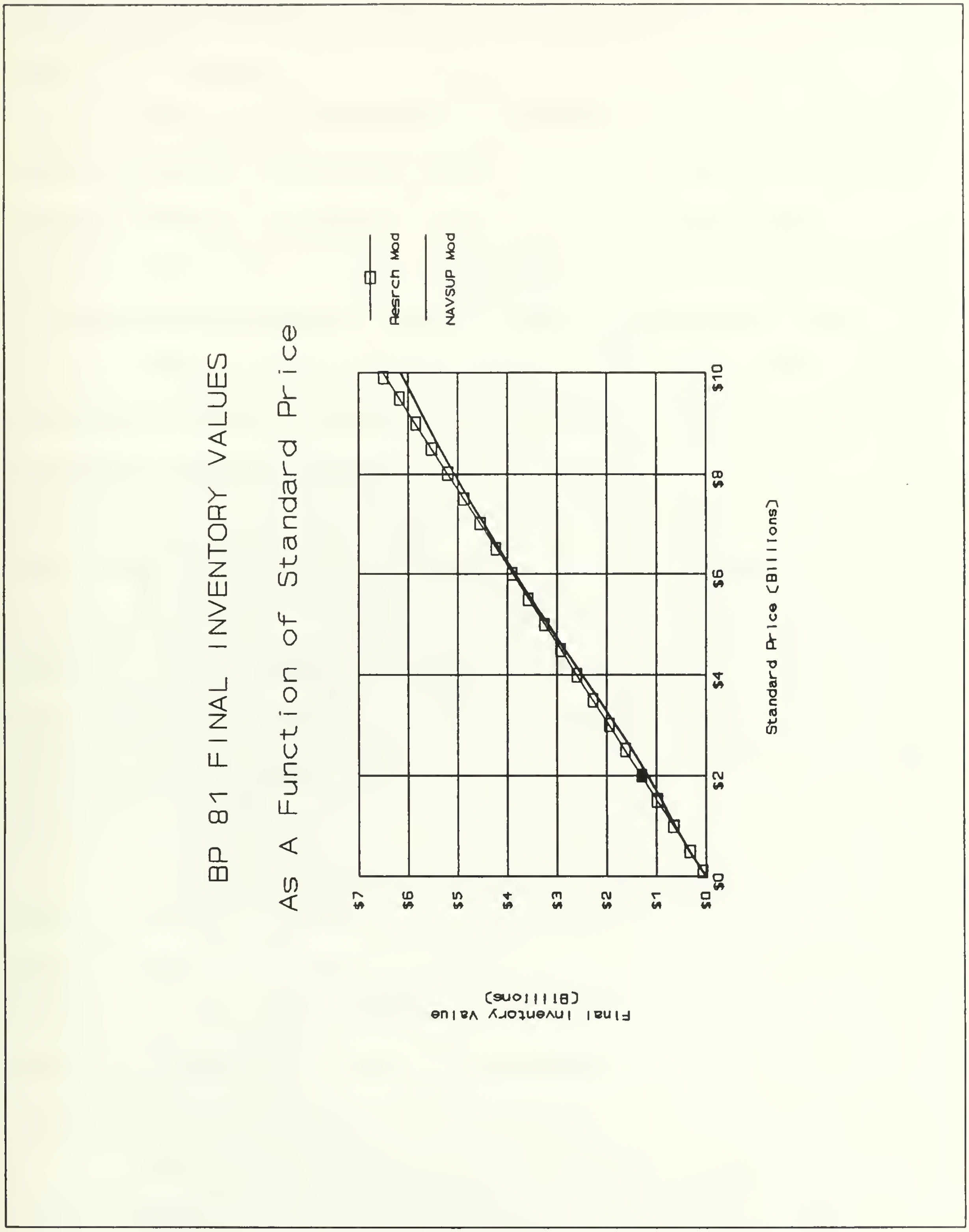

BP 81 FINAL INVENTORY VALUES
As A Function of Standard Price
Final Inventory Value (Billions)
Standard Price (Billions)
Resrch Mod
NAVSUP Mod
$0
$1
$2
$3
$4
$5
$6
$7
$0
$2
$4
$6
$8
$10

Figure 15

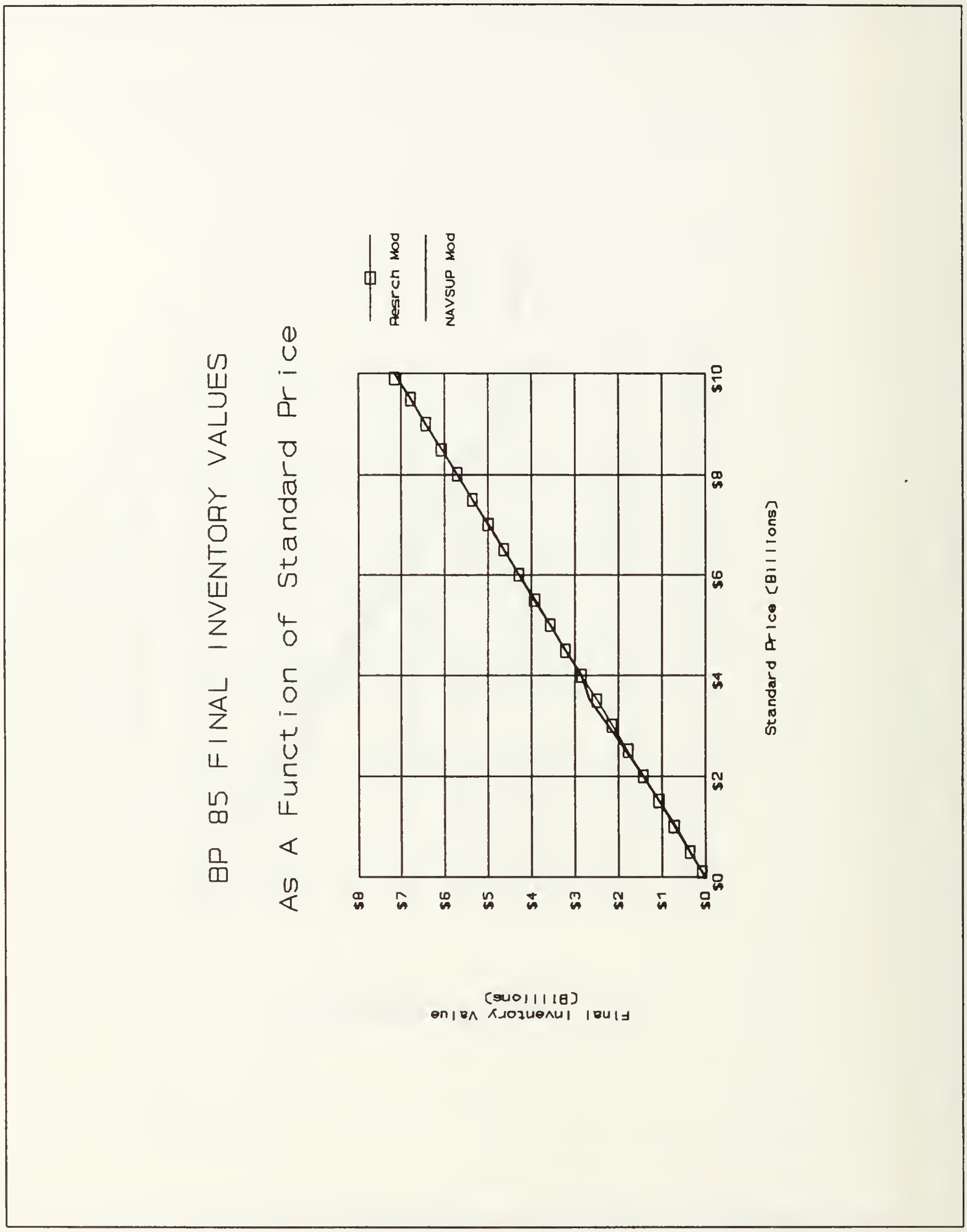

BP 85 FINAL INVENTORY VALUES
As A Function of Standard Price
Resrch Mod
NAVSUP Mod
Final Inventory Value (Billions)
$0
$1
$2
$3
$4
$5
$6
$7
$8
Standard Price (Billions)
$0
$2
$4
$6
$8
$10

Figure 16

other budget project produces on average materially biased inventory values.

Table 13 illustrates the degree of accuracy in the proposed NAVSUP model. The average accuracy of (11.7%) for Budget Project 14 suggests that on the average Budget Project 14 produces material inaccuracies in final inventory values over the entire range of the intervening variable.

Table 13 shows that the proposed NAVSUP model also produces material inaccuracies in Budget Project 81 that understate final inventory values as much as (10.4%). However, this one materially inaccurate value is an outlier. The average bias of (4.1%) and the average accuracy of (4.2%) indicate that Budget Project 81 is not materially biased nor materially inaccurate over the entire range of the intervening variable. This conclusion is supported by Table 12 which shows that Budget Project 81 is biased at the $2 billion mark only.

Altogether, the proposed NAVSUP model calculated final inventory values at 21 individual points within the range of the intervening variable for each of the four budget projects. Of the 84 total calculations performed, the proposed NAVSUP model chose approximate acquisition cost 59 times. The research model choose market value 84 times.

The proposed NAVSUP model altered its decision from cost-to-market in Budget Projects 34 and 85, For Budget Project 34 the proposed NAVSUP model chose approximate

acquisition cost up to the point where the value of inventory at standard price was $4 billion. From $4.5 billion up to $10 billion the proposed NAVSUP model chose market value. Consequently, the remainder of Graph 9 shows no difference between the proposed NAVSUP and research models.

Likewise, for Budget Project 85 the proposed NAVSUP model chose approximate acquisition cost up to the value of inventory at standard price of $3.5 billion. From $4 billion up to $10.0 billion the proposed NAVSUP model chose market value.

Figure 16 does not show the value of inventory at standard price for Budget Project 85 above $10 billion. However, if the value of inventory at standard price were to continue to increase past $10.5 billion, the proposed NAVSUP model would select approximate acquisition cost. Therefore, this example demonstrates that the proposed NAVSUP model chooses cost or market value over certain ranges of the intervening variable, and may vary its choice between cost and market several times as the intervening variable increases.

Figure 12 displays what the cumulative final inventory value would be if each budget project increased the value of inventory at standard price from zero to $40 billion in $2 billion increments. Figure 12 makes an arbitrary assumption that the value of inventory in each

budget project is the same (for example, the value of inventory at standard price in each budget project is $10 billion multiplied by four budget projects equals the $40 billion inventory at standard price). This arbitrary assumption allows the four budget projects to be added together and present the overall effect. However, this is an arbitrary assumption. Subsequent graphs that show "cumulative final inventory values" make the same assumption.

E. SUBSIDIARY QUESTION NUMBER THREE

1. Subsidiary Question

The third subsidiary question asks, "Holding constant all other variables and increasing the percentage of insurance material, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?"

2. Research Methodology

Holding constant all other variables including standard price, this section increases the mix of insurance material at standard price from 0% to 100% in 5% increments in both the NAVSUP and research models. The mix of replenishment material decreases in proportion to the increase of insurance material, and this allows standard price to remain at a constant dollar value. Within each model the test is conducted separately by budget project,

and the four budget projects are added to determine the cumulative final inventory values.

3. Data Presentation

Tables 14, 15 and 16 summarize the results from Figures 17 through 21. Tables 14 and 15 indicate the amount of bias and the range of the intervening variable which produce material differences in the proposed NAVSUP model. Table 16 shows how accurate the proposed NAVSUP model is.

Figure 17 shows how increases in the insurance material mix affects the cumulative final inventory value. Figures 18 through 21 show how this intervening variable affects final inventory values for budget projects 14, 34, 81 and 85. Figures 17 through 21 indicate material differences between final inventory values with darkened boxes.

4. Analysis

Table 14 indicates that the proposed NAVSUP model produces final inventory values that are on average materially biased in Budget Projects 14 and 34. The average bias of (11.2%) indicates that Budget Project 14 is biased in understating final inventory values by a material amount. Likewise, Budget Project 34 has an average bias of (10.3%), and materially understates final inventory values. Table 15 shows that in Budget Projects 14 and 34 the proposed NAVSUP

model produces material differences in the ranges of 65% insurance material and greater.

Table 16 illustrates the degree of accuracy in the proposed NAVSUP model, and indicates that on average the proposed NAVSUP model produces in all four budget projects final inventory values that are materially inaccurate over the range of the intervening variable.

Altogether, the NAVSUP model calculated final inventory values at 21 individual points from zero percent to 100% of insurance material for each of the four budget projects. Of the 84 total calculations performed, the proposed NAVSUP model chose approximate acquisition cost 52 times and the research model choose market value 84 times.

The proposed NAVSUP model alters its decision from market-to-cost in all four budget projects. When the proposed NAVSUP model changes the selection of cost or market at the decision point, the model produces a sharp spike in final inventory values that are particularly significant in Budget Projects 34, 81 and 85. For example, Figure 19 shows that for Budget Project 34 the proposed NAVSUP model produced final inventory values that decrease in a smooth line from $2,400 million to $2,100 million as insurance material increases from zero percent to 35%. When the insurance percentage hits 40%, the proposed NAVSUP model produces a final inventory value of $2.2 billion that creates a sharp spike in the plotted line. The proposed

NAVSUP model continues to produce final inventory values that are greater than the research model until the percentage of insurance material exceeds 50%.

The decision point between cost and market value in the proposed NAVSUP model causes these spikes in final inventory values. As insurance material increases from zero to 35% in Budget Project 34, the NAVSUP and research models chose market value, and consequently there is no difference in the final inventory values between the two models. However, when insurance material is 40% and greater, the proposed NAVSUP model chose approximate acquisition cost and produced a final inventory values that created a spike in the graph. In contrast, the research model chose market value and produced a final inventory value that extended the smooth linear line.

TABLE 14
INFLUENCE OF THE
INSURANCE MATERIAL PERCENTAGES
ON BIAS

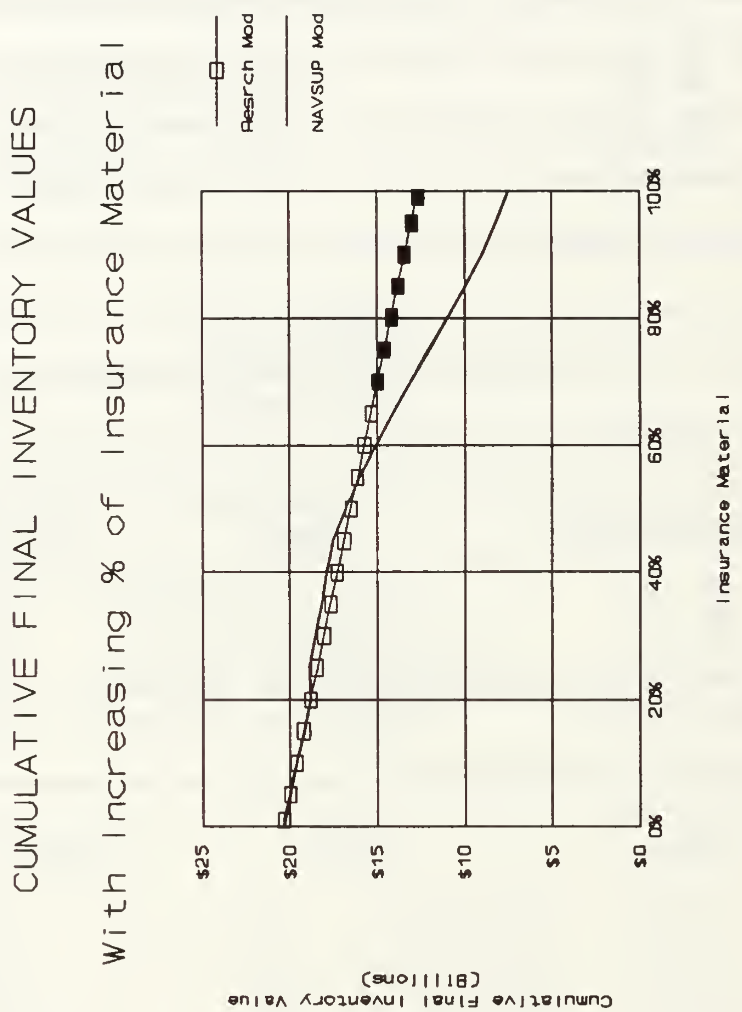
Budget Project	Bias Range	Average Bias
BP 14	1.6% to (41.1%)	(11.2%)
BP 34	7.7% to (41.1%)	(10.3%)
BP 81	3.6% to (41.1%)	(9.5%)
BP 85	5.5% to (41.1%)	(7.9%)
Cumulative	3.5% to (41.1%)	(9.0%)

TABLE 15
RANGE OF INSURANCE MATERIAL PERCENTAGES
WHICH PRODUCE MATERIAL DIFFERENCES
IN THE PROPOSED NAVSUP MODEL

Budget Project	Range of Insurance Material Percentages
BP 14	65% and greater
BP 34	65% and greater
BP 81	70% and greater
BP 85	75% and greater
Cumulative	70% and greater

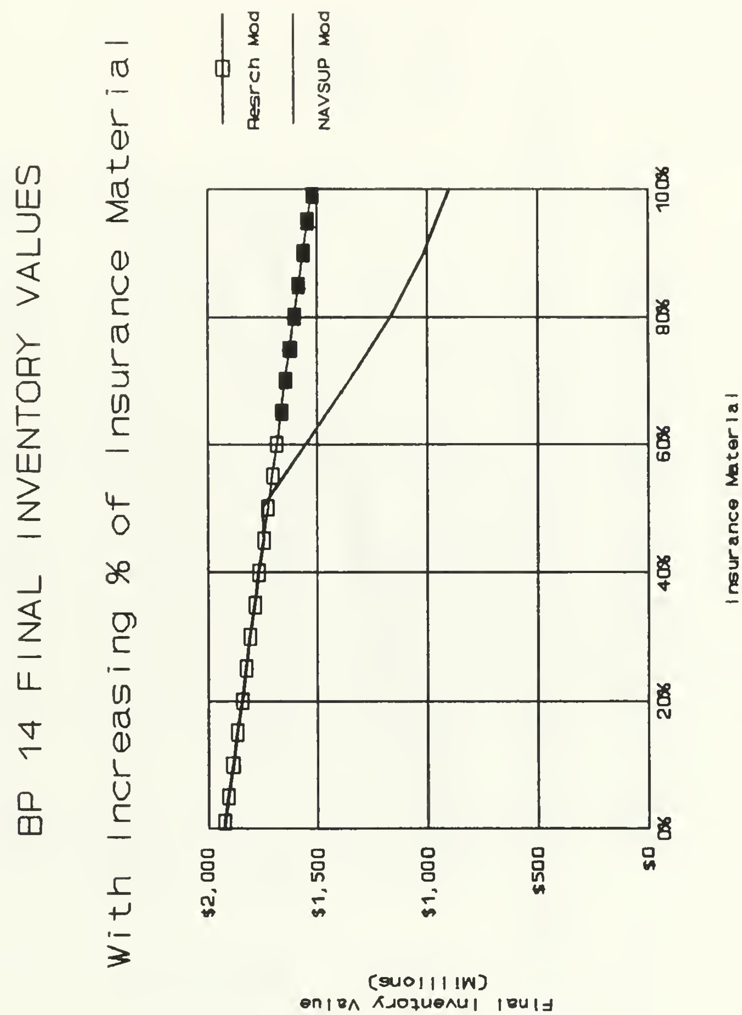
TABLE 16
INFLUENCE OF
INSURANCE MATERIAL PERCENTAGES
ON ACCURACY

Budget Project	Accuracy Range	Average Accuracy
BP 14	0.0% to 41.1%	11.3%
BP 34	0.0% to 41.1%	11.4%
BP 81	0.0% to 41.1%	10.0%
BP 85	0.0% to 41.1%	10.5%
Cumulative	0.0% to 41.1%	10.6%



CUMULATIVE FINAL INVENTORY VALUES
With Increasing % of Insurance Material
Resrch Mod
NAVSUP Mod
$25
$20
$15
$10
$5
$0
0%
20%
40%
60%
80%
100%
Insurance Material
Cumulative Final Inventory Value
(Billions)

Figure 17



BP 14 FINAL INVENTORY VALUES
With Increasing % of Insurance Material
Resrch Mod
NAVSUP Mod
Final Inventory Value
(Millions)
$2,000
$1,500
$1,000
$500
$0
0%
20%
40%
60%
80%
100%
Insurance Material

Figure 18

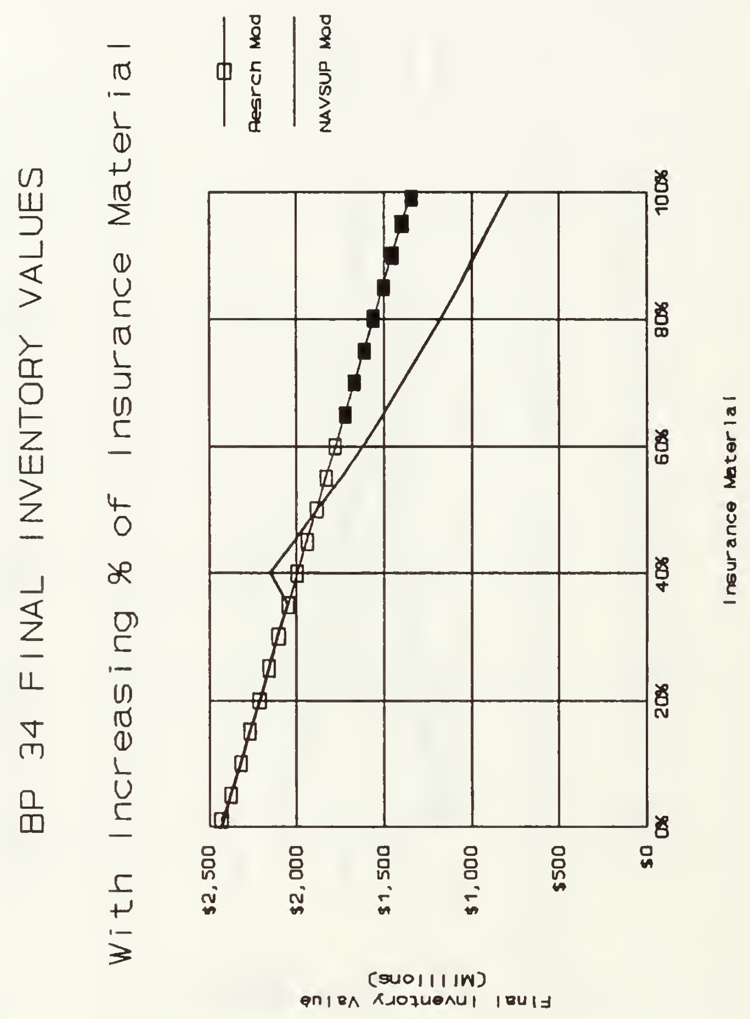
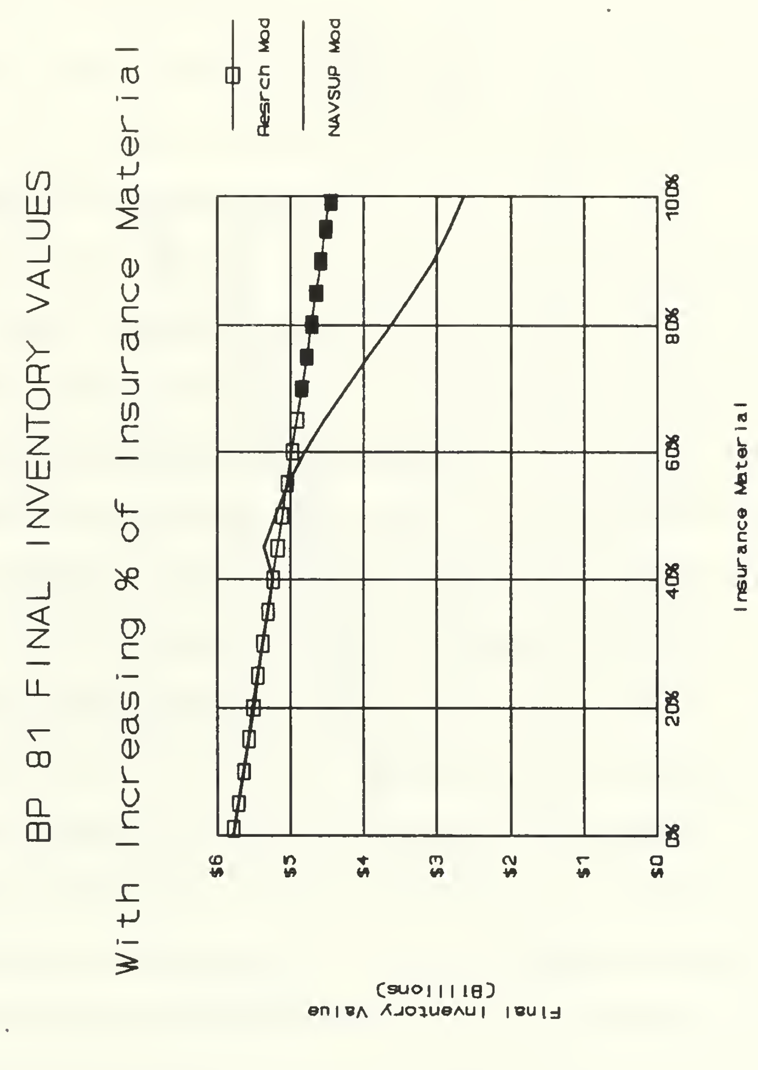

BP 34 FINAL INVENTORY VALUES
With Increasing % of Insurance Material
Resrch Mod
NAVSUP Mod
Final Inventory Value
(Millions)
$2,500
$2,000
$1,500
$1,000
$500
$0
0%
20%
40%
60%
80%
100%
Insurance Material

Figure 19



BP 81 FINAL INVENTORY VALUES
With Increasing % of Insurance Material
Resrch Mod
NAVSUP Mod
Final Inventory Value
(Billions)
$6
$5
$4
$3
$2
$1
$0
0%
20%
40%
60%
80%
100%
Insurance Material

Figure 20

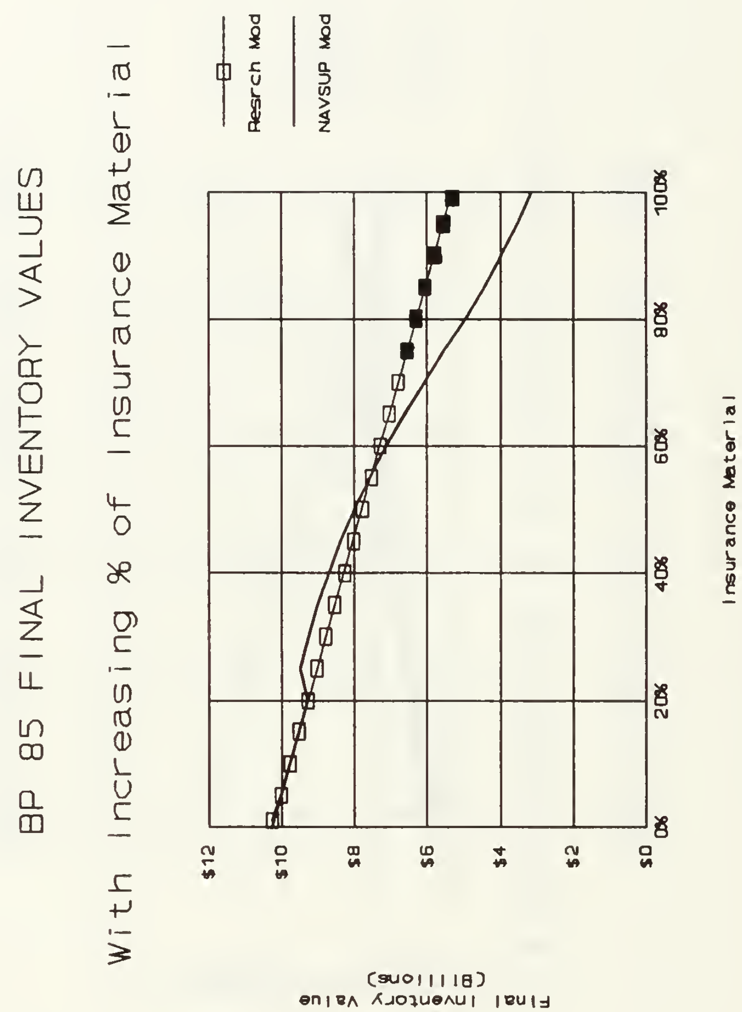

BP 85 FINAL INVENTORY VALUES
With Increasing % of Insurance Material
Resrch Mod
NAVSUP Mod
$12
$10
$8
$6
$4
$2
$0
0%
20%
40%
60%
80%
100%
Insurance Material
Final Inventory Value
(Billions)

Figure 21

F. SUBSIDIARY QUESTION NUMBER FOUR

1. Subsidiary Question

The fourth subsidiary question asks, "Holding constant all other variables and increasing the amount of annual sales at standard price, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?"

2. Research Methodology

Holding constant all other variables, this section increases annual sales in both the NAVSUP and research models from $100 million to $1 billion in $100 million increments, and determines its effect on final inventory values. Within each model the test is conducted separately by budget project, and the four budget projects are added to determine the cumulative final inventory values.

3. Data Presentation

Tables 17, 18 and 19 summarize the results from Figures 22 through 26. Tables 17 and 18 indicate the amount of bias and the range of the intervening variable which produce material differences in the proposed NAVSUP model. Table 19 shows how accurate the proposed NAVSUP model is.

Figure 22 shows how the increase in annual sales affects the cumulative final inventory values for the NAVSUP and research models. Figures 23 through 26 show how this

intervening variable affects final inventory values for budget projects 14, 34, 81 and 85.

4. Analysis

Table 17 indicates that the proposed NAVSUP model produces final inventory values that are on the average materially biased in Budget Project 14 only. The average of (12.1%) indicates that Budget Project 14 is biased in understating final inventory values by a material amount. Table 18 supports this analysis, and shows that in Budget Project 14 the proposed NAVSUP model produces material differences in the ranges of a) $100 million and less in annual sales, and b) $400 to $800 million in annual sales.

Table 17 also shows that at selected individual points in the range of the intervening variable Budget Projects 34, 81 and 85 produce material biases that understate final inventory values. For example, Budget Project 81 could understate final inventory values by as much as (24.9%). However, the average bias for each of these three budget projects is less than 10%. Therefore, on average these three budget project are not materially biased over the entire range of the intervening variable.

Table 19 illustrates the degree of accuracy in the proposed NAVSUP model, and indicates that only in Budget Project 14 does the proposed NAVSUP model produce final

inventory values that are materially inaccurate over the entire range of the intervening variable.

In addition, Table 19 shows that the proposed NAVSUP model could produce in Budget Projects 34, 81 and 85 material inaccuracies in final inventory values at certain levels of annual sales. However, the average accuracy for these three budget projects is less than 10%, and on average the proposed NAVSUP model does not produce materially inaccurate final inventory values for these budget projects.

Altogether, the proposed NAVSUP model calculated final inventory values at 11 individual points from a level of annual sales of $1 million to $1 billion for each of the four budget projects. Of the 44 total calculations performed, the proposed NAVSUP model chose approximate acquisition cost 38 times and the research model choose market value 43 times. Figure 26 shows that in Budget Project 85 the proposed NAVSUP model altered the selection at the decision point from cost to market. However, Figure 34 shows that in Budget Project 34 the proposed NAVSUP model altered the selection at the decision point from cost-to-market and then from market-to-cost. Figure 23 shows the only instance where the research model altered its selection at the decision point. When annual sales was $1 million, the research model altered its selection from cost-to-market.

TABLE 17
INFLUENCE OF
ANNUAL SALES
ON BIAS

Budget Project	Bias Range	Average Bias
BP 14	(6.9%) to (22.2%)	(12.1%)
BP 34	9.1% to (12.4%)	(0.3%)
BP 81	(1.5%) to (24.9%)	(9.6%)
BP 85	7.1% to (15.5%)	(7.0%)
Cumulative	2.4% to (18.5%)	(7.5%)

TABLE 18
RANGE OF ANNUAL SALES
WHICH PRODUCE MATERIAL DIFFERENCES
IN THE PROPOSED NAVSUP MODEL

Budget Project	Range of Annual Sales
BP 14	$100 million and less
BP 14	$400 million to $800 million
BP 34	$100 million and less
BP 81	$300 million and less
BP 85	$400 million and less
Cumulative	$1600 million and less

TABLE 19
INFLUENCE OF
ANNUAL SALES
ON ACCURACY

Budget Project	Accuracy Range	Average Accuracy
BP 14	6.9% to 22.2%	12.1%
BP 34	0.0% to 12.4%	4.2%
BP 81	1.5% to 24.9%	9.6%
BP 85	0.0% to 15.5%	8.9%
Cumulative	0.7% to 18.5%	8.0%

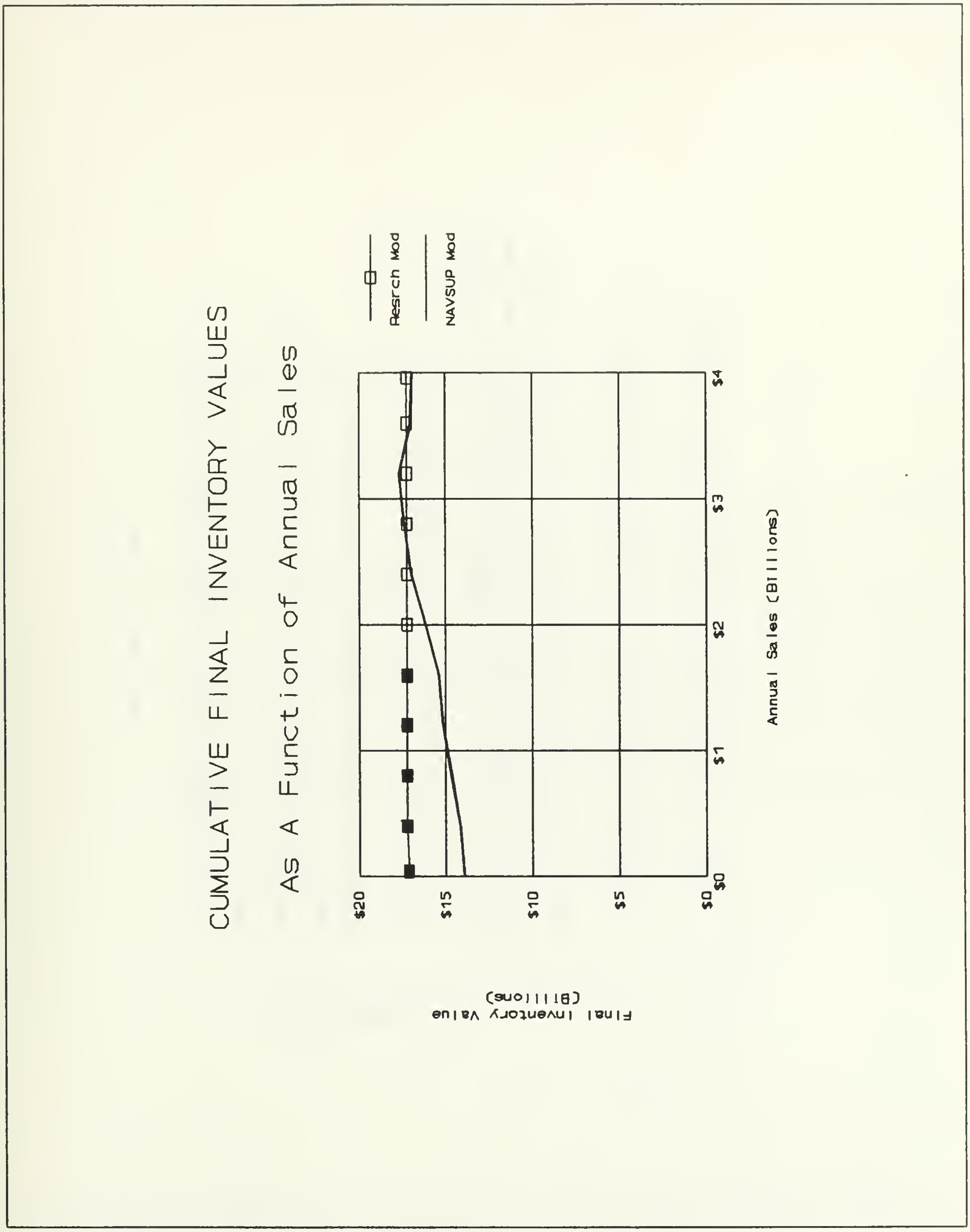
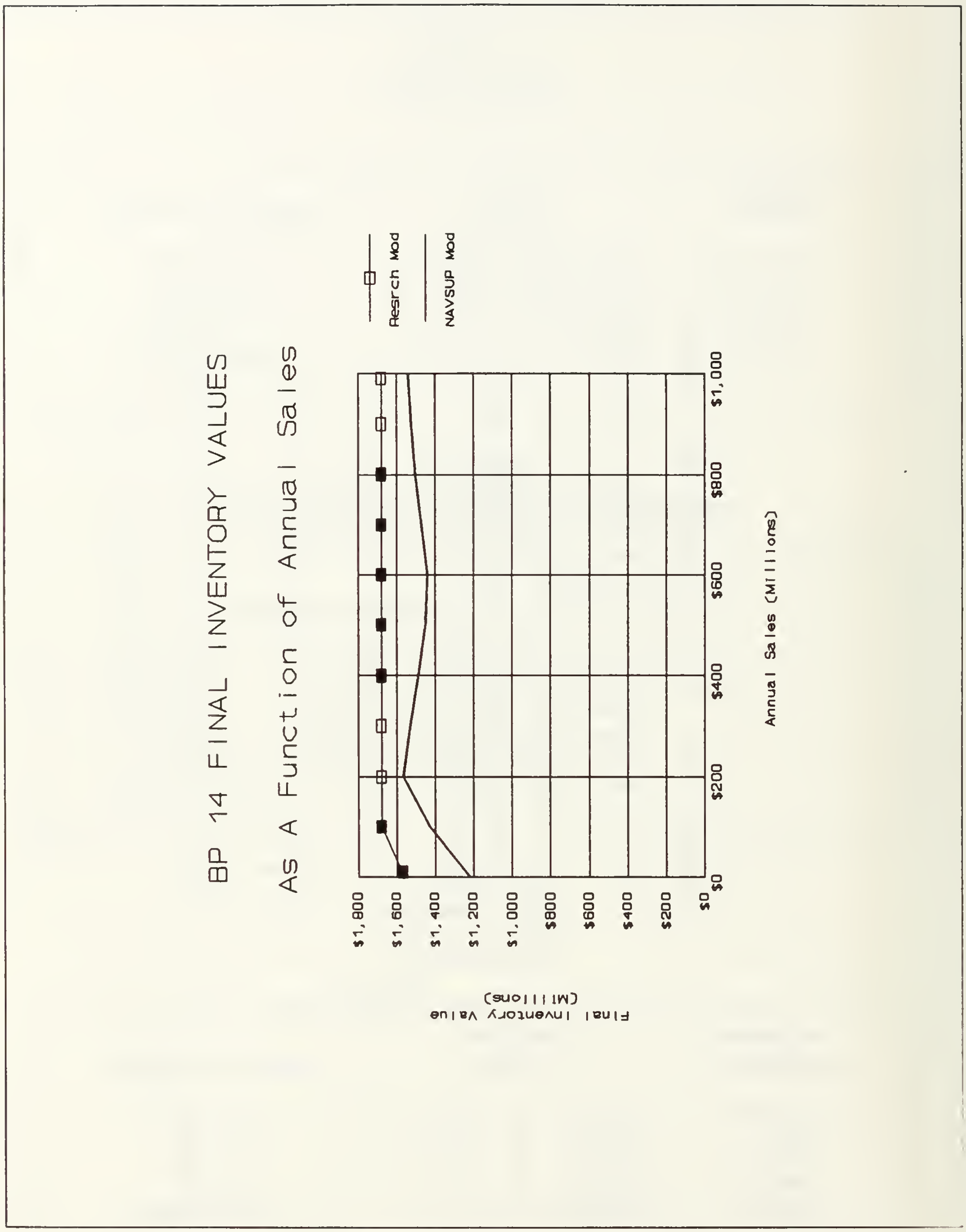

CUMULATIVE FINAL INVENTORY VALUES
As A Function of Annual Sales
Resrch Mod
NAVSUP Mod
$20
$15
$10
$5
$0
$1
$2
$3
$4
Annual Sales (Billions)
Final Inventory Value
(Billions)

Figure 22



BP 14 FINAL INVENTORY VALUES
As A Function of Annual Sales
Resrch Mod
NAVSUP Mod
Final Inventory Value (Millions)
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
$0
$200
$400
$600
$800
$1,000
Annual Sales (Millions)

Figure 23

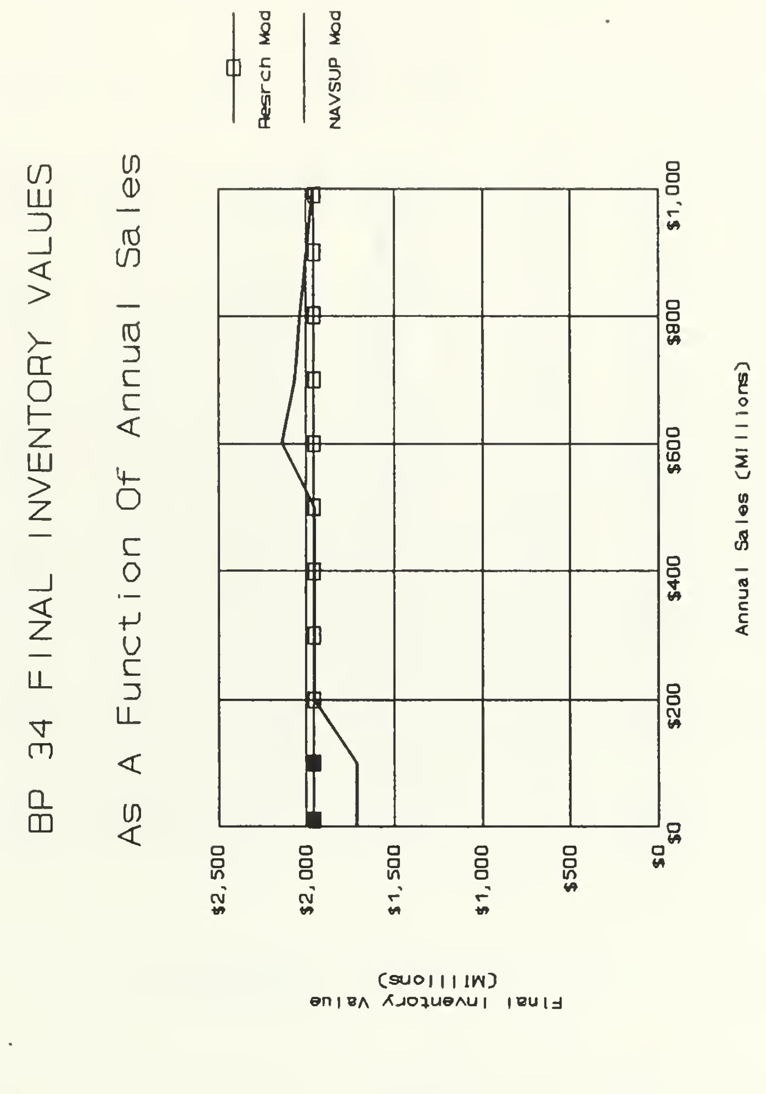

BP 34 FINAL INVENTORY VALUES
As A Function Of Annual Sales
Resrch Mod
NAVSUP Mod
Final Inventory Value
(Millions)
$2,500
$2,000
$1,500
$1,000
$500
$0
$0
$200
$400
$600
$800
$1,000
Annual Sales (Millions)

Figure 24

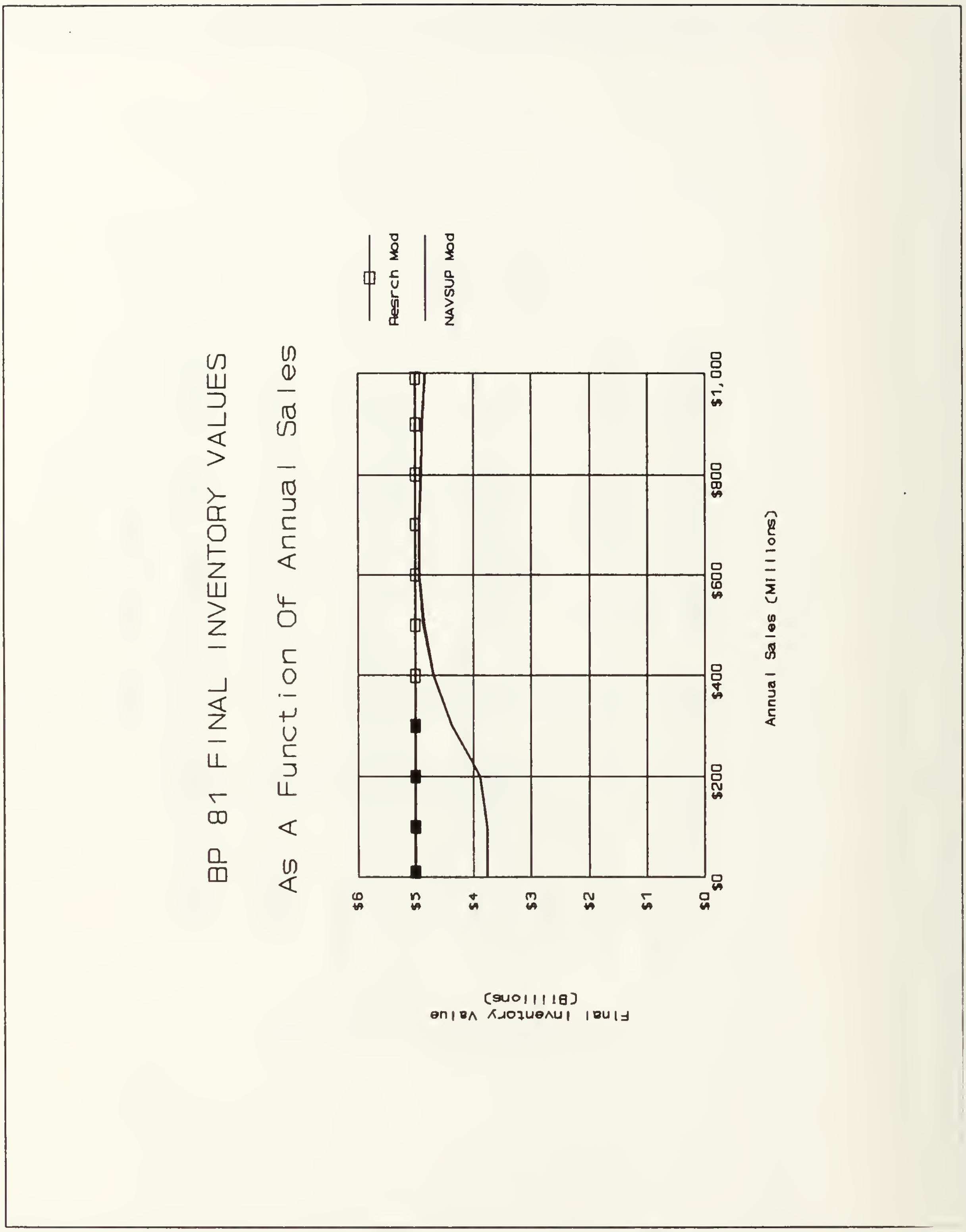

BP 81 FINAL INVENTORY VALUES
As A Function Of Annual Sales
Final Inventory Value (Billions)
$0
$1
$2
$3
$4
$5
$6
Annual Sales (Millions)
$0
$200
$400
$600
$800
$1,000
Resrch Mod
NAVSUP Mod

Figure 25

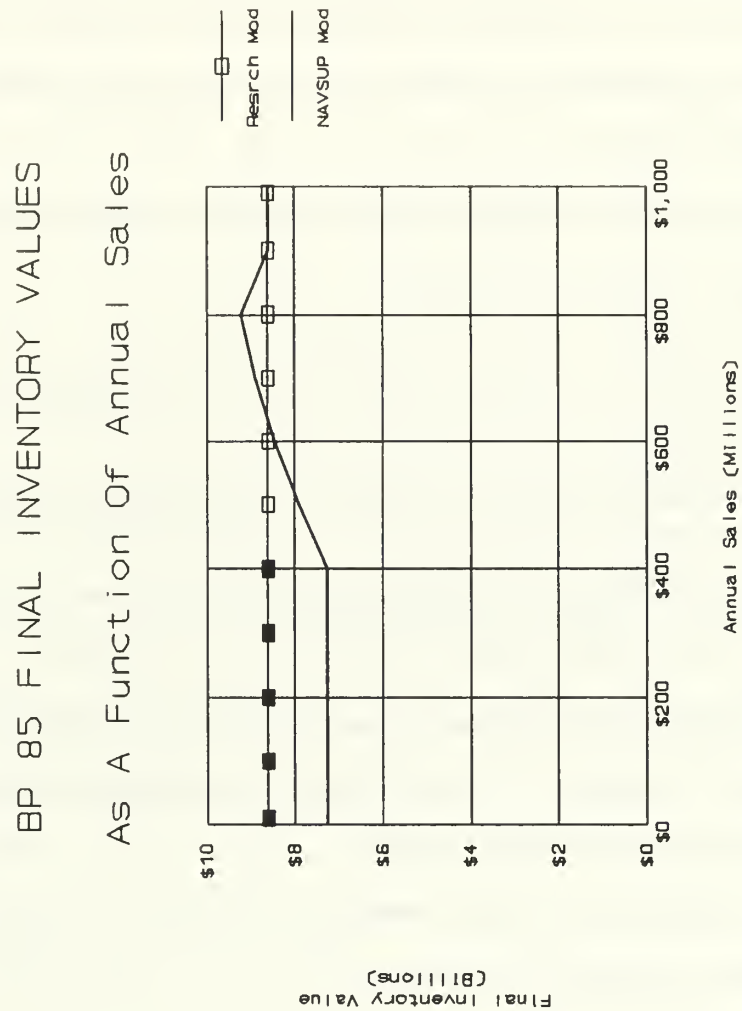

BP 85 FINAL INVENTORY VALUES
As A Function Of Annual Sales
Resrch Mod
NAVSUP Mod
$10
$8
$6
$4
$2
$0
$0
$200
$400
$600
$800
$1,000
Annual Sales (Millions)
Final Inventory Value (Billions)

Figure 26

G. CONCLUSION

This chapter described the sensitivity analysis and comparisons between the proposed NAVSUP and research models that were done. In the simulated FY 1990 financial statements the proposed NAVSUP model produced final inventory values that were not materially different from the research model.

The proposed NAVSUP model produces material differences in Budget Project 14 when:

1. The value of inventory at standard price is stated between $1 and $2 billion inclusive, and $6 billion and greater;
2. The percentage of insurance material is 65% and greater;
3. Annual sales is $100 million and less, or between $400 and $800 million inclusive.

The proposed NAVSUP model produces material differences in Budget Project 34 when the percentage of insurance material is 65% and greater.

The proposed NAVSUP model produces material differences in Budget Project 81 when:

1. The value of inventory at standard price is at $2 billion (only);
2. The percentage of insurance material is 70% and greater;
3. Annual sales are $300 million and less.

The proposed NAVSUP model produces material differences in Budget Project 85 when:

1. The percentage of insurance material is 75% and greater;
2. Annual sales are $400 million and less.

During the conduct of the sensitivity analysis several observations were made. First, when the proposed NAVSUP model chooses market value at the decision point and the research model chooses market/"condition" value at the decision point, the final inventory values produced by both models are the same.

Second, as the three intervening variables (the value of inventory at standard price, the insurance material mix, and annual sales) were changed, the proposed NAVSUP model altered its selection between cost and market nine times at the decision point. In addition, the proposed NAVSUP model may alter this selection more than once within the same budget project. For example, when the value of inventory at standard price for Budget Project 85 was increased, the proposed NAVSUP model chose approximate acquisition cost (up to $3.5 billion), market value (up to $10.0 billion), then back to approximate acquisition cost (starting at $10.5 billion).

Finally, the proposed NAVSUP model chose approximate acquisition cost 153 times during the course of 216

variations in the intervening variables, or 70.8% of the time. When the proposed NAVSUP model altered its decision from market value to cost at the decision point, the final inventory values produced at these transition points were unexpectedly greater than previous final inventory values and created spikes in the graph line. In contrast, the research model chose market value 99.5% of the time. The research model's consistent selection of market value led to final inventory values that produced smooth line graphs.

VII. CONCLUSIONS AND RECOMMENDATIONS

The Comptroller General's policy is that the lower-of cost-or-market accounting principle must be used to determine the value of Navy Stock Fund inventory. The thesis contains two hypotheses. First, the proposed NAVSUP model should be modified to consider the "utility" and "serviceability" during the market valuation process. Second, in the cost process, the proposed NAVSUP model should use the Navy Stock Fund implicit price deflator produced by the Bureau of Economic Analysis, in the place of the Department of Defense Procurement Appropriation implicit price deflator. These changes were incorporated into the research model which was designated as the standard as to what final inventory values should be under the lower-of-cost-or-market accounting principle.

The primary objective of the thesis was to determine if the proposed NAVSUP model produced final inventory values that were materially different from the final inventory values produced by the research model. The first subsidiary question addressed final inventory values used for financial reporting purposes. The next three subsidiary questions each identified an intervening variable, and using sensitivity analysis techniques, determined how the intervening variable affected final inventory values. The findings and

conclusions are presented and discussed below.

Navy Stock Fund inventory valuation models should not adhere to a literal interpretation of the lower-of-cost-or-market accounting principle. The Navy Stock Fund operates at a zero profit margin. Consequently, if the lower-of-cost-or-market accounting principle is interpreted literally, a zero profit margin decision table would be used to determine market value for Navy Stock Fund inventories. The lower-of-cost-or-market accounting principle defined current replacement cost as the primary determinant of market value. However, the zero profit margin decision table always chooses net realizable value for market value. The use of net realizable value as the primary determinant of market value would require that the standard price of material in the NSF be the selling price in the determination of net realizable value. However, standard price is not an adequate measure of the value of inventory actually held in the Navy Stock Fund since operating costs covered in the surcharge increase standard prices above the replacement cost of the material.

A Navy Stock Fund inventory valuation model is correct to consider the "utility" and "serviceability" of the material. "Utility" reduces the value of the inventory with consideration given to obsolescence. "Serviceability" reduces the value of the inventory with consideration given to damage and deterioration. The lower-of-cost-or-market

accounting principle advocates the consideration of obsolescence, damage and deterioration in determining the utility of the material.

A Navy Stock Fund inventory valuation model should include "utility" and "serviceability" during the market valuation process. According to the lower-of-cost-or-market accounting principle, the determination of market value requires a judgement of an anticipated future value to be realized if an item is sold (NRV) and an anticipated future price to be paid if an item is acquired (CRC). The "utility" percentages measure the estimated proceeds from the future sale of PE material through the disposal process, and determine the NRV for PE material. Likewise, the "serviceability" percentages measure the estimated net proceeds (standard price less the average cost of repairs) from the future sale of the material, and determine the NRV of the material. Since "utility" and "serviceability" relate to the NRV of NSF material, it is appropriate to include them into the market valuation process.

The Navy Stock Fund implicit price deflator produced by the Bureau of Economic Analysis has several advantages over the Department of Defense Procurement Appropriation implicit price deflator, and should replace the DoD Procurement Appropriation implicit price deflator as a factor determining approximate acquisition cost in an inventory valuation model. The BEA NSF IPD is specific to the NSF, and

captures the data from price changes experienced by the two major ICPs that procure insurance material for the NSF, ASO and SPCC. The BEA NSF IPD captures these price changes from ASO's and SPCC's "Contract History File" and "Contract Status File." Finally, the BEA NSF IPD excludes retail purchases which typically would not include insurance material. The DoD Procurement Appropriation IPD includes the price changes experienced in the procurement of principal items and high-priced secondary material by all military services, and therefore is not an adequate measure of the price changes experienced in NSF insurance material only. An inventory valuation model that used the BEA NSF IPD in the place of the DoD Procurement Appropriation IPD would provide a better estimate of the cost of the inventory.

A. SUMMARY OF ANSWERS TO RESEARCH QUESTIONS

As a final summary of the information presented and discussed in this thesis, the primary and subsidiary research questions will be reiterated and briefly answered.

1. Primary Research Question: Does the proposed NAVSUP model produce final inventory values that are materially different from the final inventory values produced by the research model?

The proposed NAVSUP model will produce final inventory values that are materially different from those produced by the research model. The frequency and degree of materiality will depend on the intervening variables which include the

value of inventory at standard price, the percentage of insurance material, annual sales and many other factors.

2. Using Fiscal Year 1990 data and holding constant all other variables, does the proposed NAVSUP model create final inventory values for Fiscal Year 1990 that are materially different from those produced in the research model?

In the context of the Fiscal Year 1990 financial statements, the proposed NAVSUP model did not produce final inventory values that were materially different from the research model. The proposed NAVSUP model would have calculated a cumulative final inventory value of $17,552.3 billion, which slightly overstates (but not by a material amount) the research model's figure of $17,243.7.

2. Holding constant all other variables and increasing the value of inventory at standard price, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?

When the value of inventory at standard price is increased and all other variables are held constant, the proposed NAVSUP model will produce final inventory values that are materially different from the research model. The proposed NAVSUP model produces material differences in Budget Projects 14 and 81. Final inventory values in Budget Project 14 are materially different when standard price falls in the range of $1.0 to $2.0 billion inclusively, and $6 billion and greater. Final inventory values in Budget Project 81 are

materially different when standard price is $2 billion only.

3. Holding constant all other variables and increasing the percentage of insurance material, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?

When the percentage of insurance material is increased and all other variables are held constant, the proposed NAVSUP model will produce final inventory values that are materially different from the research model. The proposed NAVSUP model produces material differences in all four budget projects. The proposed NAVSUP model will produce material differences whenever the percentage of insurance material increases past 75% of the value of inventory in any budget project. Material differences may occur whenever the percentage of insurance material is as low as 65% in Budget Projects 14 and 34.

4. Holding constant all other variables and increasing the amount of annual sales at standard price, does the proposed NAVSUP model create final inventory values that are materially different from those produced in the research model?

When annual sales is increased and all other variables are held constant, the proposed NAVSUP model will produce final inventory values that are materially different from the research model. The proposed NAVSUP model will produce material differences in all four budget projects. The proposed NAVSUP model will produce material differences

whenever annual sales is $100 million in any budget project. Material differences may occur whenever annual sales are as high as $800 million in Budget Project 14.

B. CONCLUSIONS FROM SENSITIVITY ANALYSIS

1. The Research Model

The research model tends to select market value at the lower-of-cost-or-market decision point. In 216 observations of final inventory values, the research model chose market value in 215 instances, or 99.5% of the time.

The research model tends to produce incremental changes in final inventory values. Since market value was consistently selected, the research model produced final inventory values that plotted a smooth linear line on the graphs. Even when the intervening variables were allowed to affect final inventory values and were increased over a wide range, the research model produced incremental changes (and not sudden and drastic fluctuations) in final inventory values.

2. The Proposed NAVSUP Model

The proposed NAVSUP model tends to select approximate acquisition cost at the lower-of-cost-or-market decision point. In 216 observations of final inventory values, the proposed NAVSUP model chose cost in 153 instances, or 70.8% of the time. Market value was chosen only 29.2% of the time.

There is a greater probability that under certain conditions the proposed NAVSUP model may alter its choice between cost or market value. There were nine instances where the proposed NAVSUP model changed its selection from cost-to-market or market-to-cost. In contrast, the research model altered its choice only once.

Whenever the proposed NAVSUP model's selection changes from market-to-cost or cost-to-market, it is possible that the proposed NAVSUP model will produce final inventory values that drastically increase or decrease. These spikes in final inventory values were most apparent when the percentage of insurance material and annual sales were the intervening variables. When these two intervening variables were allowed to affect final inventory values and were increased over a wide range, the NAVSUP research model may produce sudden increases or decreases (and not incremental changes) in final inventory values. These sudden changes in final inventory values were shown in the graphs as spikes in the line.

3. Comparison Of Final Inventory Values From The Two Models

The use of the proposed NAVSUP model may materially understate final inventory values. However, it is not known if the proposed NAVSUP model may materially overstate final inventory values. When the proposed NAVSUP model understates

its final inventory values in comparison to those produced by the research model, the differences in final inventory values may or may not be material. In contrast, when the proposed NAVSUP model overstates its final inventory values in comparison to those produced by the research model, the researcher found no instances where these differences in final inventory values were material.

C. RECOMMENDATIONS

1. In order to improve the degree of compliance with the lower-of-cost-or-market accounting principle, Navy Stock Fund managers should incorporate the consideration of the "utility" and "serviceability" of NSF material into the market valuation process;

2. In order to approximate the cost of the NSF inventory more accurately, Navy Stock Fund managers should use the Navy Stock Fund implicit price deflator produced by the Bureau of Economic Analysis in the place of the Department of Defense Procurement Appropriation implicit price deflator.

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APPENDIX A: ACRONYMS

AFAO - Approved Force Acquisition Objective

AFRS - Approved Force Retention Stock

ASO - Aviation Supply Office

BEA - Bureau of Economic Analysis

BEA NSF IPD - Bureau of Economic Analysis' Navy Stock Fund Implicit Price Deflator

CPI - Consumer Price Index

CRC - Current Replacement Cost

CRS - Contingency Retention Stock

DoD - Department of Defense

DLR - Depot Level Reparable

ERS - Economic Retention Stock

FASB - Financial Accounting Standards Board

FDT - First Destination Transportation Charges

FIR - Financial Inventory Reports

FIV/N - Final Inventory Values From The Proposed NAVSUP Model

FIV/R - Final Inventory Values From The Research Model

FY - Fiscal Year

GAO - Government Accounting Office

IPD - Implicit Price Deflator

ITOR - Inventory Turnover Ratio

LCM - Lower-of-cost-or-market

NAVSUP - Naval Supply Systems Command

NRFC - Navy Regional Finance Center

NRS - Numeric Retention Stock

NRV - Net Realizable Value

NRV/C - Net Realizable Value - Ceiling

NRV/F - Net Realizable Value - Floor

NSF - Navy Stock Fund

PE - Potential Excess

PPI - Producer Price Index

SF - Standard Form

SPCC - Ships Parts Control Center

SSIR - Supply System Inventory Report

APPENDIX B - DEFINITIONS

Approved Force Acquisition Objective (AFAO) - The quantity of an item authorized for peacetime acquisition to equip and sustain the U.S. approved forces in accordance with the latest Secretary of Defense Logistics Guidance: (a) in peacetime, through the fiscal year which starts twenty-one months after the first of January of the same calendar year reflected in the asset cut-off date, including requisite on hand and on order supply levels; and (b) in wartime, from D-day through the period and at the level of support prescribed to equip and sustain allied forces by satisfying: (1) requirement to Office of the Secretary of Defense approved prestockage programs for Military Assistance Program (grant aid) countries; (2) requirements of approved supply support arrangements with Foreign Military Sale Program countries; (3) wartime requirement from D-day through the period and at the prescribed level of support for these allies authorized this support in the current secretary of Defense guidance memoranda; and (c) provide support for U.S. Government departments and agencies, as authorized, and in accordance with established agreements.

Approved Force Retention Stock (AFRS) - the quantity of an item in addition to the Approved Force Acquisition Objective, required to support and equip U.S. approved forces from D-day until production equal the rate at which the item is required.

Budget Project - A macro-level category of material used to

classify material into easily identifiable groups with the same end use.

Contingency Retention Stock (CRS) - That portion of the quantity of an item excess to the Approved Force Retention Level for which there is no predictable demand or quantifiable requirement, and which normally would be allocated as potential Department of Defense (DoD) excess stock, except for a determination that the quantity will be retained for possible contingencies. (Material to support category C ships, aircraft and other material being retained will be included in this stratum.)

Economic Retention Stock (ERS) - The portion of the quantity of an item excess to the AFRS which has been determined will be more economical to retain for future peacetime issues instead of replacement of future issues by procurement. To warrant economical retention, items must have a reasonable predictable demand rate.

Insurance material - A non-demand based, stocked, essential item for which no failure is predicted through normal usage, but if a failure is experienced, or loss occurs through accident, abnormal equipment/system failure or other unexpected occurrences, lack of replacement would seriously hamper the operational capability of a weapon or weapon system.

"Market" - A measurement of the utility of material, measured primarily by current replacement value (by purchase or by reproduction, as the case may be) except that market shall not

exceed the net realizable value and will not be less than net realizable value less a normal profit margin.

Net Realizable Value - Estimated selling price in the ordinary course of business less reasonable predictable costs of completion and disposal. Abbreviated as NRV, and also known as NRV/Ceiling.

Net Realizable Value/Floor (NRV/F) - Net realizable value reduced by an allowance for an approximately normal profit margin.

Numeric Retention Stock (NRS) - The quantity of an item in excess of all requirements objectives, but for which disposal is currently infeasible or uneconomical, or for which a management decision has been made to retain stock in the supply system. There are four categories of NRS: (1) anticipated nonrecoverable assets or forecasted condemnations of on hand unserviceable material. This material previously was included in potential excess; (2) uneconomical partial disposal, or assets reflecting partial disposals for which the cost of disposal outweighs any potential benefits from disposal; (3) unforecastable demand, or material for which accurate demand pattern cannot be established, such as insurance or inactive items; and (4) material held based on special management considerations. The considerations which can justify retention in this category are similar to those used in justifying CRS, except that the factors considered are more general in nature.

Potential Excess - The quantity of an item above all

authorized retention levels, butt for which final determination as DOD excess has not been made. Stock may not be held in this category longer than is required to determine whether to retain the stock or process is to disposal If it is retained, it must be restratified to AFAO, ERS, CRS or NRS.

Principal Items - End items and replacement assemblies of such major importance that detailed analysis and review are required at Naval Systems Commands or Headquarters, Marine Corps of all factors affecting their supply and demand throughout the supply system to include material at depot level, vase level, and in the hands of using units. Principal items specifically include the items where, in the judgement of the responsible military service, there is a need for central inventory control including centralized computation of requirements, central procurement, central direction of distribution and central knowledge and control of all assets owned by Navy or Marine Corps. Principal items include ships, aircraft, missiles, ammunition, vehicles, and other major end items of equipment.

Replenishment material - All material other than insurance material for which failure is expected and customers will provide repeated demands.

Retail Inventory - Supplies or material held below the wholesale level.

Secondary Items - All items not categorized as principal items. Secondary items include repairable components, sub-systems, and assemblies, consumable repair parts, bulk items and

material, and expendable minor end items.

"Serviceable" material - All equipment components, repair parts and consumables that require no repairs. This material complies with its intended specifications, and can be issued to stock fund customers for consumption. The proposed NAVSUP model values "serviceable" material at 100% of its replacement cost.

Stratification - The accumulation, extraction and display of basic supply data in a manner that relates assets to requirements in a specific priority and time sequence.

"Unserviceable" material - All equipment components, repair parts and consumables that are broken, do not meet their intended specifications and must be repaired before it can be issued to stock fund customers for consumption and use. The proposed NAVSUP model reduces the replacement cost of "unserviceable" material by the average amount of repairs needed to bring the asset to a fully useable state.

Utility - Without the quotation marks utility refers to the definition of "market" value.

"Utility" - With the quotation marks "utility" is a measurement that the proposed NAVSUP model employs to determine the material's usefulness; expressed as a function of the material's stocking objectives.

Wholesale Inventory - Stock regardless of funding sources, over which the inventory manager at the national level has asset knowledge and exercises unrestricted asset control to meet worldwide inventory management responsibilities.

PROPOSED CHANGES TO DOD 7420.13-R
STOCK FUND REGULATIONS

1. Page 2-3, paragraph B.2.e: Insert ", with consideration to utility and material condition," between "cost" and "in" in the third sentence.

2. Page 5-2, paragraph B.6: Change the second sentence to read "Also, an excess item may be sold to a DoD-funded customer or a Federal Government contractor at less than Standard Price, with the authorization of the National Inventory Control Point Manager, when such reduction will promote utility for a purpose that would be otherwise uneconomical and thus reduce potential losses to the Stock Fund. All reduced price sales shall be recorded as an increase in accounts "Customer Orders Accepted" for the value of the sales price and a subaccount in "Other Gains and Losses" for the difference between the sales and Standard prices and a decrease to a subaccount to "Inventory - Supplies and Materials".

3. Appendix D: Replace the opening paragraph and Steps 1 through 6 with the attached pages.

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APPENDIX D

VALUATION OF STOCK FUND INVENTORY

The following methodology shall be used on a monthly basis to convert the value of stock fund inventories to a lower of cost or market basis, with further consideration given to utility to the Inventory Manager and the current condition in inventory.

Step 1. Start with the end-of-month inventory balance at Standard Price. (all $000)

30 September 1990 Inventory at Standard Price	$8,068,500
	==========

Step 2. Determine the approximate "Market" value of inventory. For purposes of this valuation methodology "Market" is considered to be the last Replacement (acquisition) Price paid plus transportation costs to get to initial storage point. From the end-of-month inventory at Standard Price remove the current fiscal year (FY) surcharges to approximate inventory at last Replacement Price. The First Destination Transportation (FDT) surcharge should not be removed because this portion of the transportation surcharge is to cover costs of transporting items to the initial stockage point from the contractor and is, therefore, a direct cost of inventory.

Total Surcharge is	10.3%
Less the percentage for FDT of	1.0%
Equals a net total surcharge of	9.3%

Since the inventory at Standard Price is 110.3% of the inventory at Replacement Price, divide the inventory at Standard Price by 1.103 and then factor back in the FDT cost.

30 September 1990 Inventory at Standard Price	$8,068,5000
Divided by	1.103
Equals Inventory at Replacement Price	$7,315,545
Multiplied by	1.01
Equals Inventory at approximate "Market" Price	$7,388,700
	==========

Step 3. For "Cost" valuation first determine inventory turn in order to simulate inventory purchase and receipt period. Because significant portions of inventories are categorized as Insurance spares (low or no demand) as opposed to Replenishment spares (medium to high demand), separate Insurance and Replenishment inventory turn ratios may be calculated. Summary Stratification data may be used to calculate the inventory turn ratios.

	Insurance	Replenishment
Inventory at Standard Price	$4,643,300	$3,425,200
Divide by sales of the last full FY	$56,011	$526,954
Equals Inventory Turn Ratio	82.9 years	6.5 years

If the inventory turn is greater than 1 year, then deflate/inflate inventory as detailed in steps 4 through 11. If the inventory turn ratio is 1 year or less, then go directly to step 12.

Step 4. Determine the deflation/inflation factors to apply to inventory values. Source information for these factors include the OSD(C) produced table of DoD Deflators or the Stock Fund Cost Growth reports. Separate factors may be applied to the insurance and replenishment inventory categories. For example, Stock Fund Cost Growth reports are a summary measure of the relative change in prices between consecutive procurements of the same items. Factors from these reports, which could be positive or negative, may be applied to replenishment inventories which tend to be repetitively procured. Factors from the DoD Deflators table are standard rates used in budget formulation and may be appropriately applied to insurance inventories which are infrequently procured.

FY	DoD Deflators	Stock Fund Cost Growth
1990	3.97%	-11.50%
1989	3.66%	-15.57%
1988	3.22%	-11.03%
1987	3.07%	-1.47%
1986	3.35%	1.85%
1985	4.41%	7.58%
1984	6.24%	11.98%
1983	8.28%	15.10%
1982	10.13%	13.10%
.	.	.
.	.	.
.	.	.

Step 5. Determine inventory value received by FY and appropriate FY deflation/inflation factors to apply. Assume that inventory value was received in equal increments over the inventory turn period by dividing the inventory at "Market" Price (which is Replacement Price plus FDT cost) from Step 2 by the inventory turn period determined in Step 3. If the inventory turn period exceeds 20 years, then limit the period for simulating inventory receipt to a maximum of 20 years. The 20 years is representative of the average life span of a weapons system. Assume the inventory received in FY 1990 was contracted for in FY 1989 because of the impact of production

leadtime. Since FY 1990 Standard Prices were computed based upon the latest FY 1989 contract prices, application of inflation factors to the FY 1990 increment of receipts to simulate a FY 1989 "Cost" price is not required.

Insurance

"Market" Price	$4,252,100
Divided by	20.0 years
Equals	$212,605 per year

FY Received	FY Contracted	Value	Inflation Factors Annual	Inflation Factors Compound
1990	1989	$212,605	Not applicable	
1989	1988	$212,605	3.66%	3.66%
1988	1987	$212,605	3.22%	7.00%
1987	1986	$212,605	3.07%	10.28%
1986	1985	$212,605	3.35%	13.98%
1985	1984	$212,605	4.41%	19.00%
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
1971	1970	$212,605	4.67%	237.02%
Total		$4,252,100		

Replenishment

"Market" Price	$3,136,600
Divided by	6.5 years
Equals	$482,554 per year

FY Received	FY Contracted	Value	Inflation Factors Annual	Inflation Factors Compound
1990	1989	$482,554	Not applicable	
1989	1988	$482,554	-15.57%	-15.57%
1988	1987	$482,554	-11.03%	-24.88%
1987	1986	$482,554	-1.47%	-25.99%
1986	1985	$482,554	1.85%	-24.62%
1985	1984	$482,554	7.58%	-18.90%
1984	1983	$241,276	11.98%	-9.19%
Total		$3,136,600		

Step 6. Determine the approximate "Cost" value of inventory. Except for inventory received in FY 1990, which is assumed to be priced at the last contract/Replacement Price from FY 1989, reduce the inventory-received values by the compound deflation/inflation factors by FY.

Insurance

FY	Value Received	Deflation/ Inflation Factor	Cost
1990	$212,605	Not applicable	$212,605
1989	$212,605	3.66%	$205,098
1988	$212,605	7.00%	$198,696
1987	$212,605	10.28%	$192,787
1986	$212,605	13.98%	$186,528
1985	$212,605	19.00%	$178,660
.	.	.	.
.	.	.	.
.	.	.	.
1971	$212,605	237.02%	$63,084
Total	$4,252,100		$2,451,000

Replenishment

FY	Value Received	Deflation/ Inflation Factor	Cost
1990	$482,554	Not applicable	$482,554
1989	$482,554	-15.57%	$571,543
1988	$482,554	-24.88%	$642,378
1987	$482,554	-25.99%	$652,012
1986	$482,554	-24.62%	$640,162
1985	$482,554	-18.90%	$595,011
1984	$241,276	-9.19%	$265,693
Total	$3,136,600		$3,849,353

Inventory at approximate "Cost" Price: $6,300,353

Step 7. Determine the "lower of cost or market" inventory value. Compare the inventory value at "Market" Price from Step 2 with the sum of the insurance and replenishment inventory values from Step 6 and go to Step 8 using the lower value.

	Cost	Market
Total	$6,300,353	$7,388,700

Step 8. Determine the inventory strata applicable to the inventory value from Step 7. Using summary Stratification data calculate a matrix of factors which identify those portions of total stratified inventories to the insurance and replenishment categories; within these categories, identify percentages applicable to the Approved Force Acquisition Objective (AFAO), Approved Force Retention Stock

(AFRS), Economic Retention Stock (ERS), Contingency Retention Stock (CRS), Numeric Retention Stock (NRS), and Potential Excess (PE); and within these inventory strata, identify the percentage that is serviceable and unserviceable. Apply this matrix of factors to the inventory value from Step 7 to determine the inventory values associated with these categories, strata and material condition.

<u>Stratification Factors</u>

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	25.3%	11.6%	43.4%	37.8%
AFRS	1.0%	0.3%	2.0%	0.5%
ERS	20.1%	6.0%	4.8%	4.7%
CRS	1.1%	3.1%	0.1%	1.2%
NRS	0.0%	0.0%	0.0%	0.0%
PE	9.6%	21.9%	0.5%	5.0%
Total	57.1%	42.9%	50.8%	49.2%

<u>Inventory Value by Strata</u>

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$620,103	$284,316	$1,670,619	$1,455,055
AFRS	24,510	7,353	76,987	19,247
ERS	492,651	147,060	184,769	180,920
CRS	26,961	75,981	3,849	46,192
NRS	0	0	0	0
PE	235,296	536,769	19,247	192,468
Total	$1,399,521	$1,051,479	$1,955,471	$1,893,882

<u>Step 9.</u> Determine the utility value of the stratified inventory from Step 8. Inventory stratified to the AFAO is considered to have a high utility because it is applicable to requirements through the end of the budget year. Inventory stratified to AFRS and ERS has a high utility because it represents items which have a demand base and are held for economic considerations. Inventory stratified to NRS and CRS is considered to have utility until a final management decision is made to declare it excess or applicable to a higher inventory strata. Inventory having utility will not be reduced in value. Inventory stratified to PE is considered to have no utility and thus should be reduced in value. Since PE inventory will be moved to disposal, the average proceeds realized from the disposal process may be used to value PE. For example, if proceeds from disposal represent 3% (3 cents returned for every dollar disposed of), then the PE inventory from Step 8 will be reduced to 3% of its value.

Utility Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	100.0%	100.0%	100.0%	100.0%
AFRS	100.0%	100.0%	100.0%	100.0%
ERS	100.0%	100.0%	100.0%	100.0%
CRS	100.0%	100.0%	100.0%	100.0%
NRS	100.0%	100.0%	100.0%	100.0%
PE	3.0%	3.0%	3.0%	3.0%

Inventory at "Utility" Price

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$620,103	$284,316	$1,670,619	$1,455,055
AFRS	24,510	7,353	76,987	19,247
ERS	492,651	147,060	184,769	180,920
CRS	26,961	75,981	3,849	46,192
NRS	0	0	0	0
PE	7,059	16,103	577	5,774
Total	$1,171,284	$530,813	$1,936,801	$1,707,188

Inventory at approximate "Utility" Price: $5,346,086

Step 10. Determine the reduced value for inventory in an unserviceable condition. Unserviceable inventory must be repaired to bring it to a serviceable condition. Therefore, the cost of repair must be removed from unserviceable inventory value to reflect the need for repair. The average percentage cost to repair for unserviceable items can be determined from summary Stratification data. For example, if serviceable inventory is valued at 100% and the average cost to repair is 28.6% of replacement, then unserviceable inventory would be valued at 71.4% of Replacement Price.

Unserviceable Condition Factors

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	100.0%	71.4%	100.0%	71.4%
AFRS	100.0%	71.4%	100.0%	71.4%
ERS	100.0%	71.4%	100.0%	71.4%
CRS	100.0%	71.4%	100.0%	71.4%
NRS	100.0%	71.4%	100.0%	71.4%
PE	100.0%	71.4%	100.0%	71.4%

Inventory at "Condition" Price

	Insurance		Replenishment	
	Serviceable	Unserviceable	Serviceable	Unserviceable
AFAO	$620,103	$203,002	$1,670,619	$1,038,909
AFRS	24,510	5,250	76,987	13,742
ERS	492,651	105,001	184,769	129,177
CRS	26,961	54,250	3,849	32,981
NRS	0	0	0	0
PE	7,059	11,498	577	4,123
Total	$1,171,284	$379,001	$1,936,801	$1,218,932

Inventory at approximate "Condition" Price: $4,706,018

Step 11. Summary of inventory valuation process.

Value at Standard Price	$8,068,500
Value at Replacement Price	$7,315,545
Value at "Market" Price	$7,388,700
Value at "Cost" Price	$6,300,353
Value at "Utility" Price	$5,346,086
Value at "Condition" Price	$4,706,018

Step 12. Determine general ledger postings to adjust inventory value. At the end of the month, the following entry would be made in the general ledgers to adjust the inventory value at Standard Price to the estimated value at "Condition" Price:

a. Up to the amount of the difference between inventory at Standard Price and the estimated "Condition" Price ($8,068,500 less $4,706,018 equals $3,362,482), reverse the general ledger balances for inventory Standard Price gains and losses and the differences between purchases at cost and purchases at Standard Price (Purchase Price Variance (PPV)). To reverse the impact of price changes:

Dr Standard Price changes - gain	$760,000	
Cr Standard Price changes - loss		$600,000
Cr Inventory - Supplies and Materials		$160,000

To reverse the difference between purchases at cost and purchases at Standard Price (PPV):

Dr Purchases at Standard Price (PPV)	$900,000	
Cr Inventory - Supplies and Materials		$900,000

b. At this point inventory has been reduced by $1,660,000. The remaining difference between inventory at Standard Price and inventory at estimated "Condition" Price should be adjusted to "Results of Operations". The remaining difference is $1,702,482 ($3,362,482 less $760,000 less $900,000) and is adjusted as follows:

Dr Results of Operations	$1,702,482	
Cr Inventory - Supplies and Materials		$1,702,482

c. The purpose of this approach is to eliminate current year gains and losses from inventory acquisition and to remove the impact of inventory purchases on the results of prior year operations.

d. These adjustments shall be reflected in all reports prepared for the Stock Fund. At the beginning of the following month these entries shall be reversed.

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Thesis
W486 Wheelock
c.1 An analysis of a Navy Stock Fund inventory valuation model.